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## THE STANDARDISING OF ELECTRICAL PLANT.

IN our issue of May 27th last, in an article on "The Standardising of Generators, Motors, and Transformers," we referred to a discussion on this subject which had taken place at a recent meeting of the American Institute of Electrical Engineers. The outcome of this discussion was the appointment of a committee, who were instructed to consider the question of standardising and to report to the Institute; and we now have before us a copy of the preliminary report of the committee, which has been published by the Institute in order that all its members may have an opportunity of criticising it and of making suggestions before it is officially adopted or printed in permanent form.

The report deals with the following points, viz.:—Efficiency, rise of temperature, insulation, regulation, variation and pulsation, rating, classification of voltages and frequencies, and in an appendix with apparent efficiency, power and inductance factors and notation. Dealing first with efficiency, the report commences with the definition that the efficiency of any apparatus is the ratio of the net power output to the gross power input, and proceeds with the statement that electric power should be measured at the terminals of the apparatus, and that in alternating current machinery the power should be measured when the current is in phase with the E.M.F., except when a definite phase difference is inherent in the apparatus, as, for example, in induction motors. Mechanical power is to be measured on the shaft of the machine, and is to include bearing friction and windage, but is not to include loss in gearing or belts, nor the increase of bearing friction due to belt tension; with this exception, however, that when a machine is mounted on the shaft of a prime mover so that it cannot be separated from it, all losses due to bearing friction are to be excluded owing to the practical impossibility of determining them satisfactorily. We do not see why bearing friction should have been singled out as not measurable, as it appears to us that under the conditions named it will be just as difficult to measure accurately the other losses in the electrical machine, and it would have been better to treat the combination as a whole, and say that in such case the efficiency of the combination must be determined by the ratio of $\frac{\text{E.H.P.}}{\text{I.H.P.}}$, or by the steam consumption per kilowatt per hour.

After stating that all the losses may be determined individually, and should be measured at, or reduced to, the temperature of continuous operation, the report proceeds with the application of these rules to various classes of machinery, commencing with commutating machines. Under this head, we note that special attention is drawn to the importance of determining the losses due to friction of brushes on the commutator and to brush contact resistance,

but no suggestion is made as to how these losses should be measured; also, that it is stated that in calculating the excitation losses, the loss in the field coils alone should be included in separately excited machines, but that in self-exciting machines the loss in regulating rheostats should also be debited to the machine. Why the separately excited machine should be more favourably treated than the self-exciter is not stated, and if any difference is to be made between the two, it should rather be that the whole energy required to drive the exciter should be debited to the separately excited machine.

In alternating current machinery, it is proposed to measure the bearing friction, windage, hysteresis, and eddy current losses, by driving the machine on open circuit by a motor; and to obtain the total loss by adding to these stray losses, the $C^2 R$ losses in armature and fields, and also a quantity representing what are called in the report "load losses," and are defined as being the difference between the total losses under load and the sum of the losses specified above. The method of arriving at the amount of energy to be added for load losses is somewhat arbitrary, as it is proposed that the machine shall be run on short circuit and at full load current and normal frequency, by diminishing the strength of the field; then, if the energy required to drive it under these conditions, minus friction and armature $C^2 R$ losses, does not exceed 20 per cent. of the open circuit core loss, the load losses may be considered negligible. Should it be in excess of 20 per cent., then 50 per cent. of this excess should be taken as representing the load loss. We should certainly prefer, wherever possible, to determine the efficiency under load by driving the machine by a motor, the efficiency of which has already been determined at various loads.

For induction motors and generators it is proposed, owing to the importance of load losses, to run them on a brake and determine the efficiency by measuring the electric input by a wattmeter, and for transformers it is proposed to measure core losses on open circuit and $C^2 R$ losses, and to add thereto load losses measured by short-circuiting the secondary and impressing on the primary an E.M.F. sufficient to send full load current through the transformer. The load losses will be equal to the input measured by a wattmeter minus the $C^2 R$ losses.

The report next deals with rise of temperature, and not only describes methods of determining the rise, but also recommends certain maximum values of temperature rise for different apparatus. The rise of temperature should be referred to the standard conditions of a room temperature of 25° C., a barometric pressure of 760 mm., and normal conditions of ventilation. We are not told how to correct for variations of barometric pressure, nor what effect it has on the rise of temperature; but we are told that if the room temperature during the test differs from 25° C., the observed rise should be corrected by $\frac{1}{2}$ per cent. for each degree; that is, that if the temperature of the room is 35° C., the observed rise is to be decreased by 5 per cent., or if, on the other hand, the room temperature is only 15° C., the observed rise must be increased by 5 per cent. It would, we think, have been more to the purpose if some definite understanding had been come to concerning the relative position of the apparatus under test and the thermometer which measures the room temperature, as the position of this latter will greatly affect the results. The temperature is to be measured after a run of sufficient duration to allow it to reach practical constancy, except in the case of apparatus intended for intermittent service; and in electrical conductors, the rise of temperature is to be determined by their increase of resistance, a temperature coefficient of 0·4 per cent. per degree centigrade being used for copper. The maximum values of temperature rise which are recommended are in most cases 50° C. for electric circuits (measured by resistance), and 40° C. for other parts of the apparatus (measured by thermometer); but for commutators and collector rings a rise of 55° C. is allowed, and for railway motors a rise of 75° C. after one hour's run at full load.

With regard to insulation, the importance of dielectric strength rather than of insulation resistance is insisted on, and it is proposed that the latter shall be of such a value that the rated voltage will not produce a leakage current of more than $\frac{1}{100000}$th of the full load current, and that in any case an insulation resistance of one megohm shall be considered sufficient. The dielectric strength should be determined by a continued application of an alternating E.M.F. for five minutes, and the test should be made on the complete machine and not separately on its individual parts. The duration of this test does not seem long enough, as instances have been brought to our notice where apparatus has stood the high pressure test for more than five minutes, but has broken down in a quarter of an hour; and we should have been inclined to suggest at least half an hour as the time during which the high pressure should be applied. Of course the duration depends on the ratio of test pressure to working pressure, but we should prefer one and a half times the working pressure for half an hour to two or three times the working pressure for five minutes, as the latter is more likely to strain the insulation and prepare the way for a breakdown at some future time. The testing pressures recommended in the report vary from three times to one and a half times the working pressure, the higher ratio being used for the lower voltage apparatus. In this connection it may be remembered that the Board of Trade regulations require that high pressure mains shall not be brought into use unless the insulation has withstood the continuous application for one hour of twice the working pressure, and that in the draft rules the same test was to be applied to all apparatus connected to the circuit; but that after discussion of the draft rules, the test pressure to be applied to apparatus was reduced to one and a half times the working pressure.

With regard to regulation of generators or motors, it is proposed that the test should be made with constant excitation in separately excited machines, and for self-exciting machines without altering the adjustment of the regulating resistance, if there be one, and that the excitation shall be such as will give the full load output at normal speed. Under these circumstances the regulation of voltage, current, or speed shall be measured by the ratio of the maximum variation of voltage, current, or speed to the full load value whilst passing from full load to no load, the speed being kept constant in generators, and the voltage or current being kept constant in motors according to whether they are to be operated on a constant potential or constant current circuit. Referring to the rating of machinery, it is recommended that both electrical and mechanical power should be expressed in kilowatts, and that alternating current apparatus should be

rated on the basis of non-inductive condition, *i.e.*, with the current in phase with the terminal voltage.

The report concludes with the recommendation of certain standard voltages and frequencies, viz., 125, 250, and 550 volts for low pressure continuous current generators, and 110, 220, and 500 volts for continuous current motors and other receiving apparatus. For receiving apparatus on alternating current circuits, the voltages recommended are 110, 220, and 440 volts, and it seems a pity that these same voltages should not have been adopted for continuous currents, or, at any rate, that the same voltages should not be recommended for both continuous and alternating currents, and that the two higher voltages should not, in both cases, be multiples of the lowest. It will be difficult to arrange a three-wire system for 220-volt lamps between the outer and middle conductors, and for 500-volt motors between the outers; and yet we suppose it is probable that three-wire systems, with more than 220 volts between the outers, will at some not very distant period be used in the United States, and that when that time comes a choice will have to be made between 220-volt lamps and 440-volt motors, or 250-volt lamps and 500-volt motors. The frequencies recommended for alternating current apparatus are 25 ~, 40 ~, 60 ~ and 120 ~, and it is probable that one or other of these frequencies would suit the conditions of working of any undertaking. Whether this recommendation will find favour or not is another matter; as we believe, to take an example, that 120 ~ is a frequency which is not largely used, whereas a large amount of apparatus working at 133 ~ is already in use in the United States.

The report deals with most of the important questions which are of interest to the user and manufacturer of electrical apparatus, and will, we expect, have provoked a good deal of criticism at the meeting of the Institute at Omaha, where it was to be discussed by the members. We have referred to it at some length, as the question of standardising is occupying the attention of electrical engineers in this country; and, although it is probable that some of the recommendations are not what would suit English requirements, yet the report of a committee, composed of such well-known men as Messrs. Crocker, Hutchinson, Kennelly, Lieb, Steinmetz, Stillwell, and Elihu Thomson, cannot fail to be of interest to all who are trying to find a way of helping the industry by standardising the requirements of the users of electric plant.

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The Discovery of the Electric Light.

We contradicted last week the statement made by a Russian writer that a Prof. Petroff had discovered the electric arc in 1802, 11 years before Sir Humphry Davy. We shall read with interest the documents on which he bases his assertion. For the present, it will be sufficient to refer him to the "Life of Sir Humphry Davy," by J. Ayrton Parris (1831, H. Colburn and Richard Bentley, New Burlington Street), and to the "Collected Works of Sir Humphry Davy, Bart," edited by his brother John Davy, M.D., F.R.S. (Smith, Elder & Co., Cornhill). We may call his attention to the following extracts, which are eloquent:—

"The earlier experimenters on animal electricity noticed the power of well burned charcoal to conduct the common galvanic influence.

I have found that this substance possesses the same properties as metallic bodies in producing the shock and spark when made a medium of communication between the ends of the galvanic pile of Signor Volta."—Letter of Davy to Mr. Nicholson, October, 1800.

The apparatus employed in these experiments was composed of 150 series of plates of copper and zinc of 4 inches square, and 50 of silver and zinc of the same size. The metals were carefully connected with four boxes of wood in regular order, after the manner adopted by Mr. Cruikshank, and the fluid made use of was water combined with about $\frac{1}{100}$th part of its weight of nitric acid. . . .

When the circuit in the batteries was completed by means of small knobs of brass, the spark perceived was of a dazzling brightness, and in apparent diameter, at least, $\frac{1}{4}$th of an inch.

It was perceived only at the moment of the contact of the metals and it was accompanied by a noise or snap.

When, instead of the metals, pieces of well-burned charcoal were employed, the spark was still larger and of a vivid whiteness, an evident combustion was produced, the charcoal remained red hot for some time after the contact, and threw off bright corruscations.—"An account of some experiments on galvanic electricity made in the Theatre of the Royal Institution" (*Journal of the Royal Institution*, Vol. i., 1802).

Many electricians will be surprised to hear that in several old and modern English books there is no mention of the discovery of the electric light by Sir Humphry Davy, and that in the French books, Du Moncel, *l'Eclairage Electrique*, by Alglave and Boulard, the first experiments made by Sir Humphry Davy are represented as having taken place in 1813. Evidently, the Russian writer, under the impression that the information given by Du Moncel and others was correct, and having heard of the experiments made by Petroff, who may have repeated at the end of 1802 the ones made by Davy several months before at the Royal Institution, jumped at the conclusion that it was his countryman who had discovered the electric arc. *Errare humanum est!*

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**Electric Furnaces.**—Those who are endeavouring to exploit commercially the electric furnace, should (if they read French) study a paper which has recently been read before the Paris Academy of Science by Gin and Leleux. In this paper the authors discuss several very important matters which have a practical bearing upon the management of the electrical furnace. Briefly, the leading features of their paper are as follows:—The characteristic fall of potential of an arc striking across a given medium is due simply to the resistance of the mass of gas which lies between the electrodes resulting from the volatisation of the material of the electrodes or of the substances subjected to the action of the arc. If this mass of gas is regarded as a cylinder with a sectional area equal to that of the electrodes, and if this cylinder is assumed to be surrounded by a perfect thermal screen, it can be shown that the temperature of the arc would increase as the square of the density of the current and the ratio of the resistivity to the specific heat per unit volume of the atmosphere of the arc, the two latter factors being themselves variable with the temperature. When the arc is allowed to pass through a mixture such as that used in the preparation of calcium carbide, the arc forms round itself a sort of pocket, at the upper pole of which is a small crater through which carbonic oxide and the vapours of calcium oxide, calcium, and carbon escape. The volume of this cavity increases up to the point at which the heat liberated by the arc is in equilibrium with the loss of heat to the surrounding medium. After cooling, it is found that the interior of the pocket is lined with a brilliant layer of vesicular graphite, behind which is a concentric layer of crystallised calcium carbide, and behind this a layer of unaltered material. This result can be explained by assuming either that at the temperature of the arc the calcium carbide dissociated, or that part of the calcium oxide volatilised so rapidly that it escaped reduction, and an excess of carbon was left. Direct experiment shows, however, that with a sufficiently intense arc, calcium carbide is dissociated at a temperature below that at which carbon volatilises. The tension of the arc varies with the surrounding atmosphere; for example, with calcium carbide mixture when the stationary temperature is reached the tension is from 18 to 20 volts, the electrodes being 10 cm. apart, whilst with a mixture of carbon and maganese oxide the tension is only 10 volts, and the pocket formed is much larger. For further details the original paper in the *Comptes Rendus*, CXXVI., 236, should be consulted.

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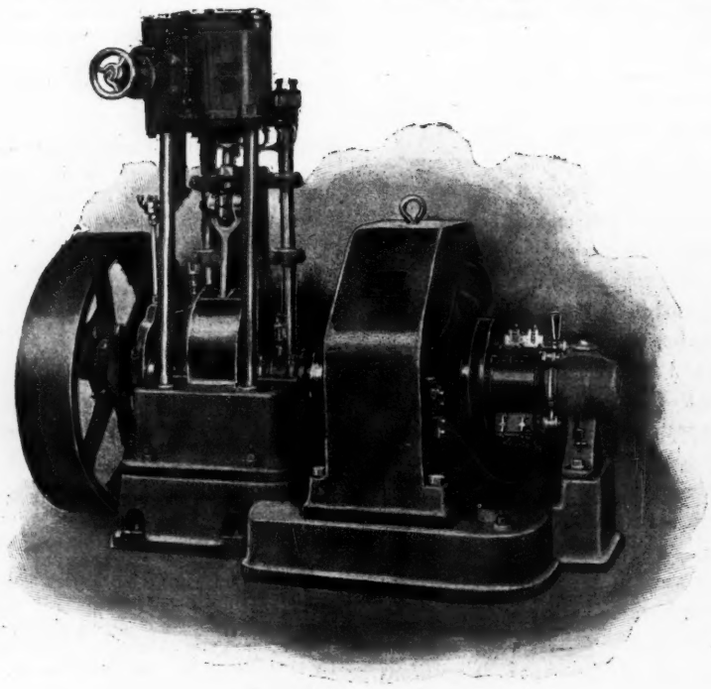
affect the results. The temperature is to be measured after a



## ELWELL-PARKER STANDARD MARINE GENERATING PLANT.

We reproduce below from the New York *Electrical Engineer* an illustration of the standard marine generating set recently brought out by the Elwell-Parker Electric Company of America, Cleveland, O. This apparatus has been developed by years of experience of the requirements in this class of machinery when used under the exacting conditions that prevail on shipboard. These sets are manufactured in sizes from 5 kw. to 40 kw., and, although designed, as we have noted, for special marine work, their compactness and satisfactory results have commended them strongly for stationary isolated installations in various classes of work on shore.



Elwell-Parker Plant.

The dynamo is designed for a minimum weight, and to run sparklessly without any overheating. All connections are easily accessible, and any parts that need adjustment or renewal are so disposed as to make the most convenient arrangement.

The engine is designed to be very open, and all parts are made to be readily accessible. The bearings are extra large, and the oiling arrangements are such as to secure continuous oiling with the minimum of attention. The whole set is rigid and strong, so as to be proof against the jarring to which it is so much subjected on shipboard in rough weather.

The shaft has a coupling between the engine and generator so that each half of the set shall be, as it were, practically independent of the other half. The outboard bearing is self-aligning, self-oiling, removable and made to gauge so as to be interchangeable. A considerable number of these sets have been in use for some time on the American lake steamers and have always given the most satisfactory results.

The accompanying cut shows the 10 and 20-kw. sizes. The 10-kw. size runs at 450 revolutions, the 15-kw. at 400 revolutions and the 20-kw. at 350 revolutions per minute.

## BOILER TESTING.

The recent explosion of a steam boiler at the depôt of the Rochdale, Bury and Oldham Tramways Company is significant of two things. One is, that with steam tramways the boilers of the locomotives are a source of danger to the public; and the other is, that the inaccessibility of the tubular boiler for inside inspection is such as to render these boilers apt to become unsafe even in the hands of experienced men. Both these dangers would be removed if all tramways were electrically operated. The steam power would be at central stations, and the boilers would be of a size and variety to admit proper periodical inspection. It appears that the boiler which exploded at the Bury depôt had two bulges in the fire box, and had been tested to 250 lbs. pressure; but no one had gauged the boiler while the pressure was on. Obviously a water pressure test is made to show where there is weakness, and parts which can move ought to be gauged before, during, and after, the application of the pressure, or how else can the pressure effects be known? Originally made 12 years ago for 125 lbs. pressure, the boiler was working at 140 lbs., a curious instance of change of pressure.

We have frequently pointed out the valueless nature of the hydraulic test save in expert hands. Excessive tests like the one applied to this boiler are very liable to rupture something, and leave the boiler just ready for explosion. Careful gaugings will show sometimes whether any important stay has failed, but at the best the hydraulic test is no substitute for inspection.

The Tramway Company have had to pay £100 towards the cost of the inquiry. They were condemned for not providing competent inspection of their boilers. The cost of inspection is so very slight, that it is surprising so successful a company did not have it done regularly. It is not pleasant to think of these little tramway engines being ready to burst in a crowded thoroughfare, and one naturally turns to electric traction as a way out of the difficulty. Apart, however, from this obvious fact, it is important that the false sense of security engendered by a haphazard hydraulic test should be dissipated.

The hydraulic test is, or should be, considered as a scientific implement requiring a very peculiar skill to interpret its indications. Only a skilled man ought to be allowed to use it, and even in his hands much that it indicates may be merely negative, and the value can only be even approximated by very careful consideration of all collateral evidence. That these truths are understood appears from recent correspondence from practical men which has appeared in the *Practical Engineer* since the explosion, but they are not understood by many men who are responsible for steam boilers, and one correspondent rightly blames the Marine Department of the Board of Trade, whose surveyors were at one time so insistent upon the hydraulic test. In New York at one time, if not now, a cartload of common or garden policemen would call on steam users with a force pump, couple this up to the boilers, and test them to so much above the working pressure, and grant a certificate on this alone. This police attitude of mind is a common lay attitude towards steam boilers, as though a complex structure could be proved like a piece of hemp rope. The hydraulic test will not show grooving or corrosion. It may, in good hands, indicate faulty stays. If a boiler stands the test applied it is at most known that it did stand it, but it is not known whether the brutal test broke a few stays and left the boiler weaker than before. To properly inspect some boilers they require to be completely gutted. This need not be done every year. With ordinary water much may be assumed, by an experienced man, from the appearance of visible parts, as to the condition of parts that are invisible. Few realise the enormous gross loads upon the bottom fire box rings of loco. type boilers, and these are apt to become grooved internally, and this can only be estimated by such "inspection" as is possible through the mud holes, and this is usually done by hand, and can only extend an inch or two on each side of the hole. The fire box crown can be seen through the lateral

man-hole, but the stud stays are out of all reach. Locomotive type boilers ought to be avoided where water is corrosive or liable to form scale, and boilers of more easily visible type should be adopted. The central station with electrical traction offers facilities for this, in that a stationary boiler may be selected from a wider variety of forms than the boiler of a locomotive.

## THE ELIESON-NAYLOR CONTROLLER.

This controller or switch has been designed by Messrs. C.P. Elieson and W. S. Naylor.

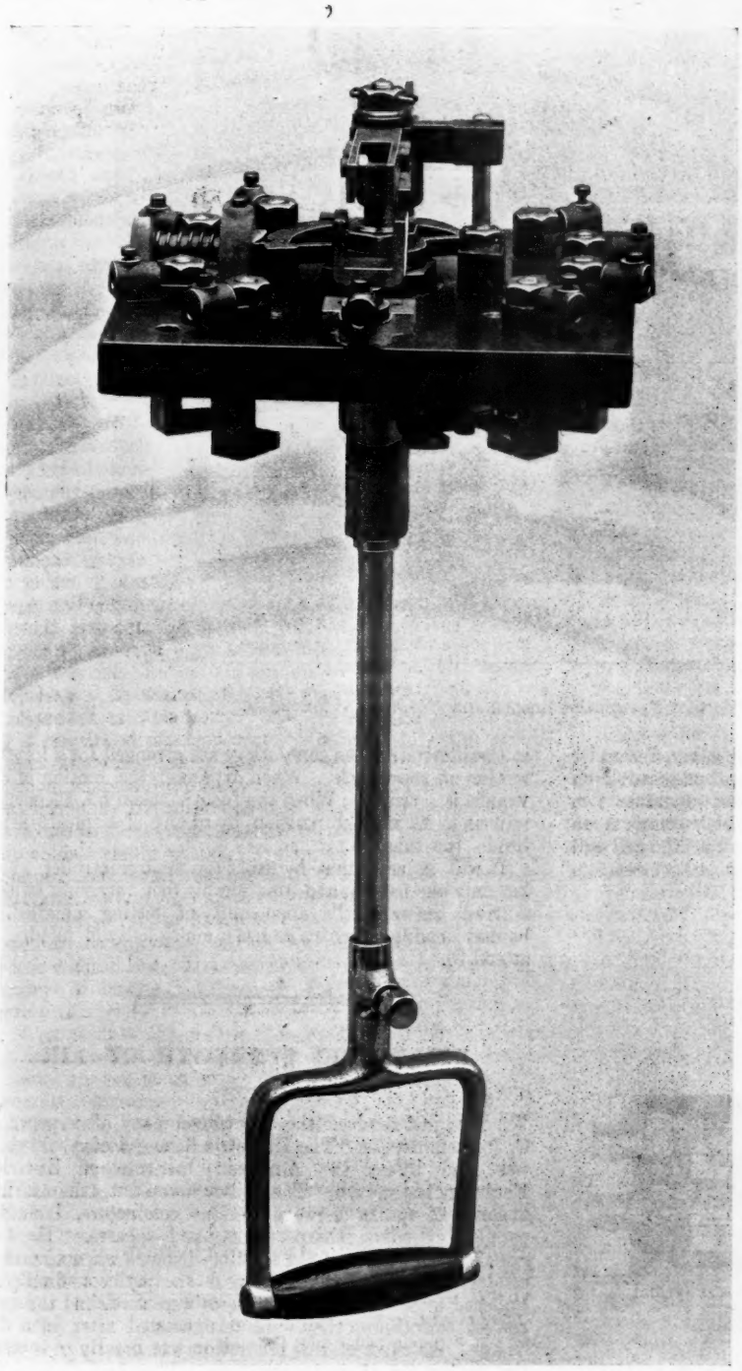


Fig. 1.—The Elieson-Naylor Controller for Electric Automobiles.

The controller is intended for use in connection with any electrically propelled vehicle, either tramcar or ordinary road "motor car."

The inventors' aim has been to combine three points which are of fundamental importance in the design of a controller for electric automobiles, namely :—

1. Simplicity.
2. Ease and quickness of breaking the circuit, without destroying the working contacts by sparking.
3. Reliability of contact.

All who have had any experience in driving electric cars through the crowded thoroughfares of London, will be well aware of the constant breaking and making of the circuit of the car, especially when slowly moving along behind a long line of traffic. It is no exaggeration to say that it is sometimes necessary to break the circuit 20 times in a minute.

Take, for instance, the case of a four-speed controller. Suppose the contact block is on the third-speed connection, in order to break the circuit the block will have to be run back across contacts two and one. This means that for one breaking, sparking will take place at three distinct contacts. Again it is often absolutely necessary to be able to start on a quick speed and not slowly get up speed by moving the controller contact from the first to the third or fourth contact piece.

In order to accomplish this and also to obviate the sparking at each contact piece, an auxiliary switch has been added for breaking and making. Bearing in mind their first aim, viz., simplicity, the inventors have so arranged that this auxiliary switch (see figs. 1 and 2) is worked by the same handle as the main contact block. The circuit is broken by merely depressing the handle and completed by raising it.

This auxiliary switch consists of four contacts which minimises the sparking effect. If these contacts get at any time badly damaged by sparking, they may quickly be renewed, and at a trifling cost compared to the cost of renewal of the main contact pieces. It is, of course, clear that in whatever position the controller contact block is, the circuit may be instantly broken by merely depressing the handle and without in any way interfering with the speed combination, so that the car restarts at the same speed that it was running at before it was necessary to stop, or slow down. Another point which is quickly appreciated by those who drive electric vehicles is, that breaking the circuit is accomplished without having to move the wrist or arm through a large angle. With reference to the third aim, viz., reliability of contact. It has been found that it is difficult to tell when the moving contact block attached to the controller handle is in central position with the contact slabs fixed to the base. For it is possible to get sufficient contact to keep the vehicle in motion, but at the same time the contact pieces may be heating owing to insufficient area of contact for the current.

It is, of course, possible to have a dial and a pointer, but in actual practice it is found that, especially in crowded streets, the driver has no time to look at a dial, but must constantly look ahead. Again, this difficulty may be overcome by a stiff spring and notch arrangement, but this obviously interferes with easy and quick manipulation. Referring to fig. 2, which is a plan of the back of the controller, the position there shown is when the main contacts

are perfectly central one above the other. Then the roller pin at the top of the figure is in one of the curved openings on the quadrant. When the contacts are in any position not exactly central one with the other, the roller pin runs on the periphery of the quadrant, thus pressing on the end of the pin marked A. This presses together two metal strips, not shown in the figure, which complete an electric bell circuit. Thus it will be seen that the bell will always ring except when the main contacts are exactly central one with the other.

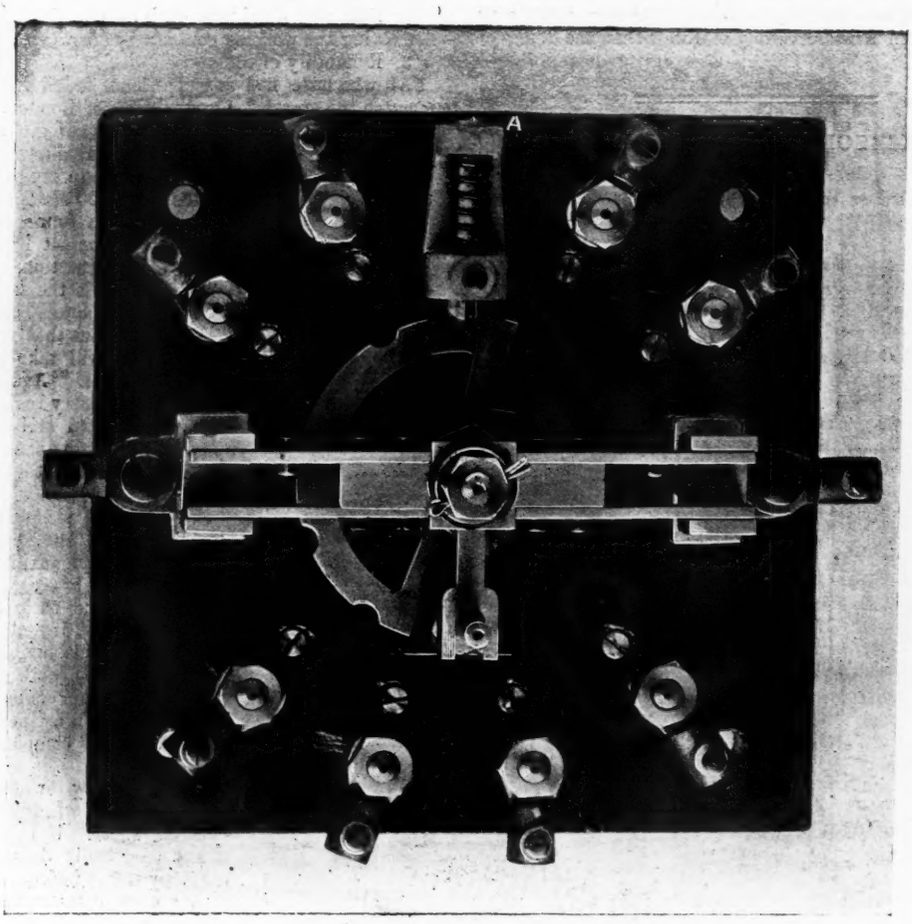



Fig. 2.—The Elieson-Naylor Controller for Electric Automobiles.

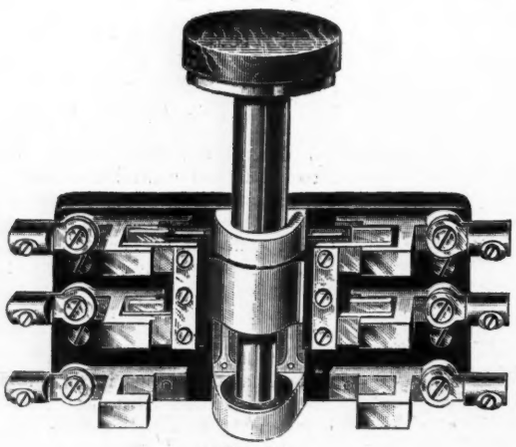


Fig. 3.

In fig. 3 is shown a simple foot switch, by the same inventors, which may be used either for reversing the direction of the current through the motor, and consequently the direction of motion of the vehicle, or as an electric brake in case of emergency. When it is in the position shown in the illustration the connections are arranged for a forward motion of the vehicle. When depressed the motion of the vehicle is reversed. When the foot is taken off, the switch returns to its normal position by means of a spiral spring inside the tube.

It will be seen that by using the main controller which has only one handle, and this simple foot reversing switch, a driver has very little opportunity of getting muddled, as he may readily do where he has a multiplicity of handles to attend to.

## DIELECTRIC STRENGTH OF AIR.

We have just received the provisional copy of a paper by C. P. Steinmetz on "The Dielectric Strength of Air," which was read before the American Institute of Electrical Engineers last month. The author investigates the striking-distance of sparks between various conductors, including parallel cylinders, sharp points, and spheres. He also examines the effect on the striking-distance when secondary conductors are placed in or near the path of discharge. Polished brass cylinders and spheres were used, and to secure perfect smoothness they were amalgamated after each discharge; the effect of this precaution was greatly to increase the uniformity of successive tests. The first part of the paper is a description of the transformers and alternators employed in the experiments. The striking-distance tests were made in the usual manner, *i.e.*, by setting the electrodes at a fixed position, then closing the generator switch, gradually increasing the exciting current, and finally noting the volts

at the instant of discharge. Special tests relate to the effect of capacity in the discharge circuit, and to the shape of the generator wave. For the latter purpose two alternators were employed, the first a smooth-core Thomson-Houston type, giving practically a sine wave; the second, a high frequency "ironclad," giving a saw-tooth form of wave.

It is important to notice the capricious nature of the discharges when a departure is made from the sine form of wave. With the "ironclad" alternator, the breaking down point was quite unstable, both for sharp points and smooth spheres; the brass spheres were polished, amalgamated, and rubbed clean before each test, with the same care as in tests with the smooth-core alternator, nevertheless the readings were far more erratic; and in several instances the same disruptive voltage occurred at striking distances, differing from one another by as much as an inch in distances all less than a foot. This has its parallel, we think, in the capricious amplitudes of "received" waves on long cables, when the E.M.Fs. at the "sending" end are not of sine form.

In the tests made with the smooth-core (sine) alternator the results are for the most part consistent. For parallel cylinders, the striking distance increases faster than the voltage; and the curves for parallel cylinders of larger diameter resemble the lower part of the curve for cylinders of less diameter, but to an increased scale. The curve representing the striking distance between sharp points starts as a straight line, the striking distance being proportional to the voltage at the rate of 20,000 volts per inch. At about 1¼ inch spark, the curve bends upward and passes into a second straight line that continues to the 3-inch spark distance; the distance here increases at the rate of 1 inch per 8,000 effective volts. This second straight line, however, does not pass through the origin, but through a point corresponding to 22,000 effective volts. Spheres ¼ inch diameter behave, at comparatively low voltages, very much as sharp points, and even intersect the curve of sharp points. This observation may remove the necessity for sharp points on lightning protectors.

Mr. Steinmetz draws a comparison between the power of resisting disruptive electrical discharges and the mechanical strength of a beam. The strength of a beam remains practically unimpaired up to a certain load, and then suddenly falls to zero. Similarly the spark-resisting power of air is practically infinite up to a certain potential, beyond which it falls to nothing, or next to nothing. The dielectric stress is represented by the electrostatic gradient; if this exceeds a certain constant value, *i.e.*, "the dielectric strength of air," a disruptive discharge occurs. Unfortunately, the experiments show that the "dielectric strength" of air, defined on this mechanical hypothesis, is not a constant; it differs according to the form and size of the electrodes, and its measurement is complicated by brush discharges. The brush discharges at high voltages do not cover a well defined area; they consist of an infinite number of streamers in rapid and violent agitation issuing from the electrodes to a greater or less distance. Moreover, this area is only partially broken down, *i.e.*, its "dielectric strength" has not quite reached zero. In mechanical parlance, it is a medium under a strain that exceeds the elastic limit of the material.

The paper represents a vast amount of experimental work. It occupies about 50 pages of the *Journal*, and contains nearly the same number of curves and diagrams. The potential differences used, 170,000 effective volts, are probably the highest that have ever been "machine made" at ordinary frequencies.

## THE PRODUCTION OF OZONE, AND A COMPARISON OF ITS COST WITH THAT OF OTHER OZIDISING AGENTS.

By JOHN B. C. KERSHAW, F.I.C.

In Article IX. of a series upon "Electricity in Relation to the Chemical and Metallurgical Industries," published by the writer in the early part of 1897, brief mention was made of the electrostatic method for the production of ozone, and of the proposals for utilising this form of oxygen for bleaching and disinfecting operations upon a large scale. Since the date of that article, a considerable number of new investigations relating to the production and utilisation of ozone have been published, and in the present article the writer proposes to give a brief description of each of the different forms of ozoniser now before the public, and then to examine the financial aspects of the use of ozone for the various purposes that have been proposed.

### I.—Production of Ozone.

*Andreoli's Ozoniser.*—The latest form of ozoniser patented by Andreoli is of the "open" type, that is, the ozonised air is in direct contact with the metal forming the electrodes, and only one dielectric surface separates the latter. These electrodes are now made of aluminium, and may be either both of the "grid" design, or one may be a plain surface of aluminium, while the other is of the "grid" variety.

The plain aluminium electrodes are formed by covering a wooden board of the size required with thin aluminium sheet; while the "grid" electrodes are formed by stretching a large number of serrated aluminium wires across a wooden frame having crossbars at intervals to keep these wires in position. The two electrodes and the sheet of glass acting as dielectric are clamped together in a wooden carrier, and any number of these units can be built up to form an ozoniser of the desired capacity. Alternating currents of high voltage are used for working these ozonisers; the 8-unit ozoniser (½ kw.) being worked with a current of 6 amperes at 85 volts in the primary circuit, and ·13 ampere at 2,800 volts in the secondary circuit. This form of ozoniser is said to yield 125 grams ozone per kw.-hour, a great advance upon the 40—64 grams per kw.-hour, which was obtained with the earlier form. No cooling is required, but the air used must be perfectly dry and free from dust. The Electric Ozone Syndicate is manufacturing these ozonisers in all sizes for industrial use, and they are said, by the makers, to be the simplest and most effective yet designed.*

*Otto's ozoniser* is made in two forms, oblong and circular. Each element is composed of a thin sheet of metal laid upon a sheet of glass, or fixed between two glass plates. In the oblong form the air enters at one end and travels in a zigzag manner between the several elements forming the ozoniser; in the circular form the air enters at the centre of the discs and passes away at the circumference. The alternate elements in each case are connected in parallel to the positive and negative poles of the transformer. Otto's chief discovery has been that of the fact that the "output of ozone is proportional to the periodicity of the alternating current used to work the ozoniser. The output per E.H.P.-hour he states is at a maximum when a periodicity of 80 per second is used. Working under these conditions he has obtained a yield of 155 grams ozone per E.H.P.-hour.

*The Yarnold ozoniser* consists of a flat shaped box containing a number of horizontal plates of glass, coated on one side with gold leaf. These metallic films are connected alternately in parallel to the two poles of the transformer. The air or oxygen is passed into the space between two neighbouring plates, and does not come into contact with the metallic film. An alternating current of about 15,000 volts potential, and 83 periodicity is used in working this ozoniser, and no cooling is required. Messrs. Yarnold & Rosenblum state that the yield of ozone with this form of ozoniser is 175 grams per E.H.P.-hour, a yield higher than any yet published.

This ozoniser is being exploited by the Commercial Ozone Syndicate of London, and is to be used by the "Ozone Oil Refineries and Industries," a company which is about to be floated for the manufacture of oils and fats by Rosenblum's patents.

*The Siemens and Halske ozoniser* consists of a number of tubes placed together to form a "tube-trellis." Each separate unit is made up of an inner metal tube, and an outer glass tube covered on its external surface with tin-foil. Water is led through the inner tube in order to keep down the temperature, and the air to be ozonised is passed through the annular space between the metal and glass tubes. The output of this form of ozoniser is stated by Dr. Frölich to be 20 grams ozone per E.H.P.-hour; and use has been

* For further information see Electrical Review, March 25th 1898, p. 400. *L'Industrie Electrique*, 1898, p. 210.

made of it at Grieffenburg in Germany since 1894 in connection with bleaching operations.

*The Tindal and Van der Steen Ozoniser.*—This form of ozone apparatus has been used at Paris in connection with experiments upon the use of ozonised air for sterilising slime water, and a small installation was exhibited at the Brussels Exhibition last year.

As the tests of the latter only indicated a yield of 3 grams ozone per E.H.P.-hour*, it is useless to include this ozoniser in the comparative tables of yields and costs given in the following portion of this article. It is only fair to state that the conditions under which the experiments at Brussels were carried out, do not appear to have been favourable, and it is possible that a much better yield of ozone per E.H.P.-hour was obtained in the Paris experiments. The writer has attempted to obtain from Baron Tindal some direct information concerning the latter, but so far without success.

## II.—Utilisation of Ozone.

Numberless uses have been suggested for the ozonised air produced in the manner described above; of these the following have all received experimental trial with more or less success :—

1. Ageing wood for musical instruments.
2. Maturing wines and spirits.
3. Sweetening foul beer casks.
4. Drying and thickening oils.
5. Bleaching waxes and fats.
6. Seasoning linoleum.
7. Bleaching fabrics and yarns.
8. Sterilising drinking water.
9. Producing vanillin and organic bodies of a similar type.

As regards some of the suggestive applications the results desired can only be obtained by the use of ozone. In many cases, however, other oxidising agents are applicable, and it thus becomes necessary to take into account the relative costs of these before deciding in favour of ozone. Designers of apparatus for the production of ozone have too often ignored this question of relative cost, and have been disposed to assume that if ozone effected the oxidising or bleaching result desired, its adoption for the purpose upon a commercial scale was certain, in spite of the fact that some other agent was attaining the same end at a lower cost.

The three oxidizing agents most commonly employed on a large scale are, bleaching powder, manganate of soda, and bichromate of soda.

*Bleaching Powder* is a mixture of calcium hypochlorite and chloride with undecomposed calcium hydrate, and its chemical formula is now written $Ca \begin{cases} Cl \\ O\ Cl. \end{cases}$ When treated with dilute acids, it yields up the whole of its chlorine, and the same effect is produced more slowly upon exposure to air containing carbonic acid. This liberated chlorine produces oxidising and bleaching effects by reacting with water to yield nascent oxygen and hydrochloric acid, according to the equation $H_2O + 2\,Cl = 2\,HCl + O$.

Thus one molecule of bleach liberates two atoms of chlorine, and these in turn set free one atom of oxygen.

The average make of bleach contains from 35 to 37 per cent. free or active chlorine. Taking the value of bleach at 35·3 per cent. Cl, we therefore find from these data that 1 metric ton bleach (1,000 kgs. = 2,204 lbs.) will yield 353 kgs. chlorine or 80 kgs. oxygen. The present price for this amount of bleach is £5 2s. 6d., and adding 20s. per ton for carriage and the costs of preparing the bleaching solution for use,† we find that 80 kgs. oxygen generated in this way will cost $\frac{122{\cdot}5}{80}$ = 1s. $6\frac{3}{10}$d. per kilo.

*Sodium Manganate.*—Turning now to the second commonly used oxidising and disinfecting agent, sodium manganate, the chemical formula of which is written $Na_2\,Mn\,O_4$, we find that in alkaline solutions a molecule of this salt parts with one atom of oxygen, whereas in acid solutions it parts with two atoms of oxygen. The equations representing these changes are as follows :—

(*a*) $Na_2\,Mn\,O_4 + H_2O = 2\,Na\,OH + Mn\,O_2 + O.$

(*b*) $Na_2\,Mn\,O_4 + 2\,H_2SO_4 = Na_2SO_4 + Mn\,SO_4 + 2\,H_2O + 2\,O.$

The sodium manganate of commerce contains only 25 per cent. of the pure salt, and is at present sold at the rate of £15 per ton. From these data we find that 1 metric ton of this salt will yield 24·2 kgs. oxygen in alkaline solutions, and 48·4 kgs. oxygen in acid solutions, and that adding 37s. for the cost of the acid requisite in the second case, and 10s. for carriage and preparation charges in both cases, the costs per kilo of oxygen are $\frac{310}{24{\cdot}2}$ = 12s. 9½d. and $\frac{347}{48{\cdot}4}$ = 7s. 2d. respectively.

*Sodium Bichromate.*—The third oxidising agent, bichromate of soda—chemical formula $Na_2\,Cr_2\,O_7$—is used chiefly in the manufacture of organic chemicals. On treatment with sulphuric acid it liberates oxygen according to the following equation :—

$$Na_2\,Cr_2\,O_7 + 4\,H_2\,SO_4 = Na_2\,SO_4 + Cr_2\,(SO_4)_3 + 4\,H_2\,O + 3\,O.$$

From this equation we find that 5·44 kgs. of this salt and 8·16 kgs. sulphuric acid are required to yield 1 kg. nascent oxygen, and taking the price of bichromate of soda at $3\frac{5}{8}$d. per lb. and sulphuric acid as before at 25s. per ton, the cost per kilo of oxygen works out to 4s.

*Ozone.*—Ozone is a condensed form of oxygen; the action of the silent electric discharge being to compress three atoms of oxygen into the space usually occupied by two. The molecule of ozone is therefore represented chemically as $O_3$; whereas the molecule of ordinary oxygen is written $O_2$.

With regard to ozone it is necessary to note that only in exceptional cases is the whole of its oxygen utilised in producing bleaching or oxidising effects, and that generally only one-third of the oxygen takes part in the reaction.* This is usually explained by the following chemical equation, which shows that when ozone is decomposed only one of the three atoms of oxygen is liberated in the nascent state :—

$$O_3 = O_2 + O.$$

The following table gives in condensed form the figures for the output of ozone, with the cost of the electrical energy necessary to produce 1 kg. ozone and 1 kg. nascent or active oxygen, by four of the various forms of ozoniser :—

| Form of ozoniser. | Yield of ozone per E.H.P.-hour. | Cost of electrical energy in pence. | |
|---|---|---|---|
| | | Per kg. ozone. | Per kg. active oxygen. |
| Yarnold ... ... | 175 | 8·56 | 25·68 |
| Otto ... ... | 150 | 9 99 | 29·99 |
| Andreoli ... | 94 | 15 90 | 47·70 |
| Siemens & Halske | 20 | 75·00 | 225·00 |
| Theoretical figures | 1,000 | 1·50 | 4 50 |

The cost of electrical energy has been taken at 1½d. per E.H.P.-hour, since it would be impossible to obtain it at a lower cost, in the small quantities demanded by ozonisers.

To the costs given in Table I., must be added the costs of working the process—drying the air, interest on capital, depreciation, &c. Taking these as equal in the aggregate to 1s.† per kilog. of ozone produced (therefore 3s. per kg. active oxygen produced), we arrive at the figures given in Table II. For purposes of comparison the figures representing the costs of 1 kg. active oxygen when obtained by chemical methods, are included in the Table.

* Andreoli in *L'Electricien*, 1898, p. 229.

† At the present prices for acid, the cost of hydrochloric acid would be 14s. and of sulphuric acid about 16s. per ton of bleach decomposed.

* *Journal Society Chemical Industry*, Vol. 16, p. 94.

† Otto estimates 1 fr. per kg. ozone.

Table II.—Comparative Costs of 1 kg. Active Oxygen.

| Source. | | Cost in pence. |
|---|---|---|
| Bleaching powder ... ... ... ... ... | | 18 3 |
| Sodium bichromate ... ... ... ... ... | | 48·0 |
| Ozone ... ... | Yarnold's ozoniser ... | 61 5 |
| | Otto's ozoniser ... ... | 66 0 |
| | Andreoli's ozoniser ... | 83 7 |
| Sodium manganate | Acid solution ... ... | 86 0 |
| | Alk. solution ... ... | 153 0 |
| Ozone ... ... | Siemens & Halske ozoniser | 261 0 |

These figures prove conclusively that bleaching powder is the most economical oxidising agent yet produced, and for all purposes in which the desired result can be attained *satisfactorily* by the use of this form of chlorine, it is absurd to speak of ozone supplanting it. The industrial applications of ozone will therefore be restricted to those processes or operations, for which at present the two sodium salts or atmospheric air are the customary oxidising agents. With reference to the former, Table II. shows that as regards cost ozone occupies a fairly favourable position; while its ease of application and non-production of solid or liquid bye-products give it a great advantage as compared with the troublesome acid mixtures that have to be handled in the case of sodium bichromate and of sodium manganate.

There is, therefore, every reason to expect that the use of ozone in the manufacture of oils, fats, and organic chemicals will rapidly extend.

Turning now to those manufacturing or other processes in which at present the oxygen of atmospheric air is the customary oxidising agent, the advantages of ozone are not so striking. The agent in each case is a gas, and produces no liquid or solid bye-products. In the one case, it costs nothing; in the other 61½d. per kilo. of active oxygen. To balance this expenditure we have only a decrease in the time required to produce the desired result.

There is also the further danger that ozone may prove too active an oxidising agent, and in the case of spirits, wines, &c., may oxidise not only the impurities desired, but also the essential constituents of the liquid. The future of ozone in respect to its application to the purification of water, and maturing of wines and spirits is, therefore, in the writer's opinion, less certain; and further experiments may prove that the older oxidation processes though much slower are, nevertheless, the more economical.

There is at present a decided attempt being made to "boom" ozone by the methods of modern journalism, rather than to extend its field of usefulness by steady experimental work and hard logical facts.

These attempts will necessarily fail, since all applications of ozone to industrial purposes must finally be judged by the test of £ s. d. Even if these attempts meet with temporary success, they will still hinder the true growth of the ozone industry; since the economic failure of ozone as an oxidising agent in cases in which it should never have been tried, will prevent its trial in others, in which it would appear to have every chance of success.

## LIQUID FUEL ON THE METROPOLITAN RAILWAY.

Apropos of the proposal to use electricity as a means of traction on the Metropolitan Railway, the *Engineer* discusses the question of partially remedying the foul tunnels by means of liquid fuel in place of solid fuel. It has been resolved to give Holden's liquid fuel system a trial, and a locomotive has been selected of 17 inches × 24 inches size, with a grate area of 17·5 square feet, and oil tanks have been fitted of 150 gallons capacity, the oil to be tried being of 0·9 specific gravity and 280° flash point. We need not at the moment follow the discussion to the distance gone to by our contemporary, and consider that to make the best use of oil, all the locomotives which run on the system must be so fitted, viz., the District, Great Northern, Great Western and Midland engines. What really concerns us just now are the points made in favour of oil by our contemporary. In the first place the tunnels would be freed of sulphur, and this would mean much, there being but little, if any, sulphur in liquid fuel. But there would also be less carbonic acid gas in the tunnels. It is pointed out that if pure hydrogen were used as fuel, there would be no carbonic acid produced, but simply so much steam. Now oil fuel consists of carbon 72 per cent. and hydrogen 28 per cent. As compared with Welsh coal, one ton of oil will do the work of two tons of coal, because of the better efficiency secured with oil.

For each 100 lbs. of oil fuel there would be produced 263·52 lbs. of $CO_2$ and 234 lbs. of water. The hydrogen would evaporate 806 lbs. of water, and the carbon would evaporate 504 lbs., or, say, 1,310 lbs. in all, at an efficiency of one half. To secure the same evaporation with carbon, only about 187 lbs. would need to be burned, yielding 684 lbs. of $CO_2$. Thus by the use of oil the production of carbonic acid gas would be under 40 per cent. of that of solid carbon fuel. All this is true, but apart from the reduction of the sulphur compounds we very much question if the benefit to be derived is not more apparent than real, apart from the fact that a real saving is made in the weight of fuel burned in the tunnels. We need not, in fact, concern ourselves so very seriously with the relative production of $CO_2$ and of steam. To burn one pound of carbon demands 2⅔ lbs. of oxygen, and produces 15,000 heat units. To burn one pound of hydrogen consumes 8 lbs. of oxygen, and produces, say, 60,000 heat units (actually only about 50,000 units are in any sense available).

Practically the heat output is proportionate to the oxygen consumed. As a medium to breathe carbonic acid gas is not poisonous. It is probably more objectionable than nitrogen. Nitrogen is not a supporter of life, and an overplus of nitrogen is in a sense as bad as an overplus of carbonic acid. Whatever fuel be employed, the same weight of oxygen will disappear per heat unit evolved. The atmosphere will be deprived of its life-preserving property, and an atmosphere of nitrogen and steam will asphyxiate. A steam-laden atmosphere will hardly support the combustion of a candle, and, therefore, is equally unsuitable for man, who is but a candle in respect of his atmospheric requirements. It is thus a fallacy to lay so much stress upon the mere reduction of carbonic acid. Apart from the poisonous carbonic oxide formed by imperfect combustion of carbon, there is little real advantage in changing from a carbon to a hydrocarbon fuel, so far as regards the maintenance of the atmosphere in a condition to support life. No one better appreciates liquid fuel than ourselves, but it is begging the whole question to urge it as a fuel for underground railways. The arguments of our contemporary are very apt to mislead: they do not include a full statement of facts, and are apt to be relied upon in opposition to electric traction. The atmosphere on the Underground is unpleasant, not altogether because it is sulphurous, but because it contains too small a proportion of oxygen. Already four-fifths nitrogen, we can ill afford even small subtractions of oxygen, and whatever fuel be employed, oxygen will disappear as such, and leave the atmosphere in a condition approximating that foretold by Lord Kelvin as the result of burning the world's store of fuel more quickly than the recuperative capacity of the world's vegetation, on which alone we depend, regenerates the atmosphere. Oil fuel is better to use, of course, because it really does save oxygen. In the Arlberg tunnel it is reported to use hardly more than one third the oxygen used by solid fuel, but this is a question of efficiency of fuel, and does not affect the principle. The *Engineer* argues merely on the ratio of steam and carbonic acid. It is to this line of argument we take exception.

## ELECTRICITY WITHOUT MACHINERY.

The above heading, with the addition of "Revolution in Electricity," appears on the announcement of the "New Electricity Supply Syndicate," formed to exploit the "Rowbotham Primary Generator." Matters have recently been quiet in the direction of primary batteries, and it is not, perhaps, surprising that a further move should have been

made, a move which, however, we venture to prophesy will have the fate of every other enterprise of the kind, namely, complete failure. We are told of the "New Electricity Supply System" that "the generators, being automatic, will require practically no attention at the hands of the consumer, and will produce electric light and power at a low cost." How often has a statement like this been put forward, possibly in all good faith, only to prove its utter worthlessness when put to the test.

What, then, is the new generator? The following is a description of the same:—

The generator consists of a series of cells mounted on an inclined plane, in order that the electrolyte may pass from one to another. The elements are carbon and iron, the former of which is not consumable, whereas the iron is consumed practically in proportion to the energy taken from the generator.

The manner in which this *remarkable* (the italics are our own) result has been obtained, is as follows:—

"The cells consist of three chambers, two of which are air-tight compartments, between which the large open compartment containing the iron elements of the battery is placed. Connecting the air-tight compartments are rows of porcelain porous tubes, through which pass carbon pencils; these are connected together, and thus form the cathode element of the battery, the iron plates (or anode elements) being placed between the rows of porcelain tubes in the open part of the cell.

The action of these cells is as follows:—A solution contained in a reservoir at the top of the cells is permitted to flow into the air-tight compartment of the top cell, and thence to the remainder of the cells. From each compartment, immediately current is taken from the generator, gas is given off from the cathode element, which exerts a pressure in the air-tight compartment, forcing the solution to penetrate through the porous tubes in about the same proportion as the energy is taken from the generator, and thus lowering the internal resistance of the generator when required, and maintaining the electrical pressure constant."

Wherein the novelty of the Rowbotham generator consists it is extremely difficult to see. The use of iron as the positive element is pretty ancient history. Blanch Brain, and especially the notorious D'Humy, and others, tried iron, but we hear nothing of their batteries now. The principle of circulation has been tried over and over again, and the use of sulphuric acid and nitric acid in which to immerse the iron is not, we believe, a novelty.

On examining the reports of Mr. Hadyn T. Harrison and Prof. Silvanus Thompson on the battery we are not vastly impressed with the tests. To take the report of Mr. Harrison first, we have practically nothing but conclusions upon which to form an idea of the value of the battery. We are told, for example, that the open E.M.F. of a cell is 1·35, and we are led to assume that an E.M.F. of 1·05 keeps constant for the whole of the time the battery is giving 100 amperes. How important it is that the current supplied to incandescent lamps should keep steady is (or ought to be) known to every electrician, it is *not* known to the public, who probably believe that a 5 per cent. fall in the power of the battery means a 5 per cent. fall in the light only. It is this falling off in the power of all batteries of the kind which has had perhaps more than anything else to do with the utter failure of primary batteries to give satisfaction. Nothing is more annoying than the fall from great brilliancy down to the red hot poker stage, which invariably takes place in installations worked continuously from primary batteries. What evidence have we from Mr. Harrison's tests that this will not take place? Why does not Mr. Harrison give the result of several hours continuous run, the one test which is of vital importance in enabling one to judge of the value of the battery? "For how long" is the question which we would ask Mr. Harrison to answer with reference to paragraph after paragraph in his report.

Prof. Thompson in his report is a little more explicit. He states "there is no polarisation during normal use." Again we would ask, "how long" will the thing last? we want something more definite than generalities, knowing as we do from past experience how utterly misleading these are.

Now as regards cost. According to Mr. Harrison, "we obtain a total cost of under 5d. per B.T.U." A total cost for what? Why simply for the raw materials consumed in the battery at the price they are quoted in the official lists. Will the cost of the iron when made into plates (or whatever form it is used in) with the necessary fittings and delivered at the consumer's door, be only a trifle more than the cost of the raw material, and will the cost of the acid be ditto? If we are to make a comparison of costs in this way we must compare the costs of the metal and acid with the costs of coal, water, and oil, &c., at the prices these are quoted officially. The public would be certain to compare the cost given, viz., 5d., with the cost of, say, 6d. charged by an electric light company for the current delivered at the consumer's door, with obviously an unfavourable view of the latter. The fact is, we have in reports of the kind not untruths but "half truths," which are most mischievously misleading in their character.

If we are to compare power-driven plants with a battery plant, we must take into consideration the relative durability of the two, a comparison which would be very much in favour of the former. The absence of this comparison is another misleading element, not necessarily intentionally omitted but still omitted.

Unless it can be definitely proved that the so-called new battery is decidedly more economical than others of the same nature which have proved miserable failures, the latter will be the fate of the new venture.

Seriously, it is a mystery how experts can be induced, in the year of grace, 1898, to issue reports of the nature we have commented upon. In the Review for January 17th, 1896, page 85, Mr. Rowbotham's battery is criticised, on February 21st, page 253, the battery, as then existing, is fully described, and even at an earlier date than these, but relating to the same thing, viz., September 6th, 1895, the "new epoch in the influence of motive power on the life and work of the world," the Board of Trade unit for 6d., just as Prof. Thompson has it now, and the usual high flown nonsense invariably associated with the primary battery craze, are to be found chronicled in our pages. Three years have virtually passed, and still we have a reiteration of the same claims, and hopes never to be realised, which were current then.

We cannot do a better service to our readers than advise them to peruse the references we have mentioned above, when they will at once recognise an old friend in a slightly modified guise.

## CORRESPONDENCE.

### The Registration of Trade Marks.

We have much pleasure in forwarding you herewith a *précis* of the facts connected with the Solio Trade Mark Appeal case recently decided in the House of Lords. As the decision is one which seriously affects all trades and simplifies the registration of trade marks for the future, we think you will be interested in commenting on the matter.

**The Eastman Photographic Materials Company, Limited.**

THE EASTMAN PHOTOGRAPHIC MATERIALS COMPANY, LIMITED.
"SOLIO" APPEAL CASE IN THE HOUSE OF LORDS.

1. The company was refused the word "Solio" in 1895 by the Registrar of Trade Marks.

2. This decision was upheld successively by the Board of Trade, Justice Kekewich's Court and the Court of Appeal.

3. The Eastman Company persevered and paid all costs in all these Courts, and in their final appeal to the House of Lords which has now reversed the decision of the previous Courts.

4. The word was originally refused as being derived from "Sol" (the Sun) and, it being possible to print silver paper in sunlight, this was held to make the word descriptive, and so, under the Act, not permissible as a Trade Mark.

5. This decision was based on a reading of the Act which held that a Trade Mark must not only be invented, but, even if invented, it must also be in no way descriptive of the goods.

6. The House of Lords has now decided that a registrable word, if it is properly an invented word, *may* contain skilful allusion to the nature of the goods referred to. But, to be held as an invention, a word must not be merely two known words strung together, nor a known word of the language with a slightly modified ending. So long as a new invented word is used and the public are not robbed of the use of a descriptive word which is the property of the community, the object of the Act is attained.

7. The origin of the word "Solio," as a matter of fact, had nothing to do with "Sol" (the Sun). It arose through an official submitting to one of the principals of the firm the word "Soho"—the business then being conducted in Soho Square. This was misread as "Solio," and so it came to be established.

8. Lord Halsbury, the Lord Chancellor (who is a distinguished amateur photographer), himself happened to be a user of the Eastman Company's Solio printing-out paper, and he made a statement to that effect, and added that it never in the world occurred to him that there was anything descriptive in the name.

9. In fact, there is just as much reason why the word "Solio," as Lord Herschell points out, should be taken to refer to boots (from the "sole") or to agricultural implements (from the Latin "Solum" the ground).

10. Full law reports appeared in the *Times* and other papers of Saturday, July 16th. Leaders have also appeared in the *Times* of Monday, July 18th, and the *Standard* of July 16th, commenting on the important change of law involved in this decision.

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### Preventing Induction in Telephone Circuits.

The method proposed by Mr. F. P. Selby in the last number of your esteemed paper, for preventing induction in telephone circuits by other electric wires, has been tried years ago here and abroad; it has been found to have *some* effect, but not enough to prevent disturbances, and has therefore, as far as I know, been dispensed with, where it has been tried.

J. G. West.

Berlin, *July 26th*, 1898.

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[Pressure upon our space compels us to hold over a letter from the Brockie-Pell Arc Lamp Company on "Arc Lighting," also one from Mr. Davenport on "Accumulators for Lighting and Traction."—Eds. Elec. Rev.]

## LEGAL.

### Lamina Accumulator Syndicate.

Before Mr. Justice Kekewich, in the Chancery Division, on Friday, Mr. Warrington, Q.C., mentioned the matter of the Lamina Accumulator (Elieson's British Patents) Syndicate, Limited, and the Elieson Lamina Accumulator Company, Limited, in which he had a motion on behalf of the Earl of Galloway for the appointment of a receiver. It stood over to enable arrangements to be made by the company in the terms of the agreement to issue to the Earl of Galloway debentures in place of the debentures he held in the syndicate. He understood that the new debentures had been sealed the previous night, and had now been handed over to the Earl, who had given his undertaking to hand in the old debentures. Under these circumstances he now proposed to stay further proceedings in the action. He understood it was arranged that defendants should pay the costs.

Mr. Bramwell Davis, Q.C., on behalf of the defendants, said the assignment to the new company had been completed only the previous day, and arrangements for the exchange of the debentures were at once made. He was not instructed to agree that defendants should pay the costs.

Mr. Warrington: Then all I can agree to is to take no order, except that costs be costs in the action.

Mr. Justice Kekewich: I think Mr. Warrington is right, and then whoever is wrong in the action will have to pay the costs.

Order made accordingly.

## BUSINESS NOTICES, &c.

**Books Received.**—"The Storage Battery: A practical treatise on the construction, theory, and use of secondary batteries," by Augustus Treadwell, jun. Whittaker & Co., London. 7s. 6d. net.

We have received from the Westinghouse Electric Company, of Pittsburg, Pa., a small pamphlet on the use of electricity for haulage in mines. The adaptability of the electric locomotive for such work on account of its compactness, and the other points of convenience of electricity are briefly stated, and a description is given of the Baldwin-Westinghouse type of locomotive for mine work.

Munro & Jamieson's "Electrical Rules and Tables' Pocket-Book," 13th edition. Chas. Griffin & Co., Ltd., London, 8s. 6d.

**Change of Address.** — Messrs. Hall Bros., electrical apparatus manufacturers, have just removed from 318, Fenchurch Buildings, E.C., and Sugar Loaf Court, Leadenhall Street, E.C., to 156, Upper Thames Street, and 21, Bush Lane, Cannon Street, E.C.

## Electrical Wares Exported.

| Week Ending July 26th, 1897. | £ | s. |
|---|---|---|
| Albany ... ... ... | 57 | 0 |
| Bangkok... ... ... | 900 | 0 |
| Bergen. Sub. cable ... | 1,564 | 0 |
| Bombay ... ... ... | 148 | 0 |
| Buenos Ayres ... ... | 306 | 0 |
| Callao ... ... ... | 2,976 | 0 |
| Calcutta ... ... | 512 | 0 |
| Cape Town ... ... | 665 | 0 |
| Copenhagen ... ... | 72 | 0 |
| Demerara. Teleg. mat. | 32 | 0 |
| Durban ... ... ... | 653 | 0 |
| East London ... ... | 135 | 0 |
| Fremantle ... ... | 824 | 0 |
| Genoa ... ... ... | 51 | 0 |
| Gibraltar. Teleg. cable | 3,000 | 0 |
| Malaga ... ... ... | 70 | 0 |
| Malmo ... ... ... | 80 | 0 |
| Mauritius ... ... | 10 | 0 |
| Melbourne ... ... | 119 | 0 |
| " Teleg. mat. | 18 | 0 |
| Ostend ... ... ... | 15 | 0 |
| Perth ... ... ... | 653 | 0 |
| Piræus ... ... ... | 10 | 0 |
| Port Elizabeth ... ... | 168 | 0 |
| Rotterdam. Teleg. wire | 56 | 0 |
| St. Petersburg ... ... | 22 | 0 |
| Santander ... ... | 14 | 0 |
| Shanghai ... ... | 294 | 0 |
| Singapore. Teleg. cable | 60,130 | 0 |
| Sourabaya ... ... | 1,870 | 0 |
| Stockholm. Teleg. wire | 159 | 0 |
| Sydney ... ... ... | 1,425 | 0 |
| Vigo. Teleg. mat. ... | 20 | 0 |
| Wellington ... ... | 523 | 0 |
| Yokohama ... ... | 1,610 | 0 |
| " Teleg. wire | 17 | 0 |
| Total | £106,233 | 0 |

| Week Ending July 26th, 1898. | £ | s. |
|---|---|---|
| Boulogne ... ... | 80 | 0 |
| Buenos Ayres. Teleg. mat. | 328 | 0 |
| Cape Town ... ... | 191 | 0 |
| " Teleg. mat. | 385 | 0 |
| Christiania. Teleg. mat. | 120 | 0 |
| Colombo... ... ... | 70 | 0 |
| Copenhagen ... ... | 127 | 0 |
| Durban ... ... ... | 500 | 0 |
| Hong Kong ... ... | 342 | 0 |
| Korsor. Sub. cable ... | 1,105 | 0 |
| Lyttelton ... ... | 161 | 0 |
| Malta ... ... ... | 124 | 0 |
| Melbourne. Teleg. mat. | 750 | 0 |
| Naples ... ... ... | 34 | 0 |
| Ostend ... ... ... | 12 | 0 |
| Paris ... ... ... | 307 | 0 |
| Penang ... ... ... | 212 | 0 |
| Port Chalmers ... ... | 46 | 0 |
| " Elizabeth ... ... | 922 | 0 |
| Rio Janeiro ... ... | 77 | 0 |
| Santos ... ... ... | 25 | 0 |
| " Teleg. mat. | 27 | 0 |
| St. Michaels. Teleg. cable | 15 | 0 |
| St. Petersburg ... ... | 585 | 0 |
| " Teleg. mat. | 70 | 0 |
| Shanghai ... ... | 65 | 0 |
| Singapore. Teleg. mat. | 72 | 0 |
| Sydney ... ... ... | 1,049 | 0 |
| Tonku ... ... ... | 368 | 0 |
| Zara. Teleg. cable ... | 1,206 | 0 |
| Total | £8,877 | 0 |

## Foreign Goods Transhipped.

| | £ | s. |
|---|---|---|
| Boulogne ... ... | 220 | 0 |
| Stockholm ... ... | 56 | 0 |
| Total | £276 | |

| | £ | s. |
|---|---|---|
| Malaga ... ... ... | 151 | 0 |
| Rio Janeiro ... ... | 903 | 0 |
| Total | £1,054 | |

**Church Lighting.**—The Keighley Electrical Engineering Company, Limited, write as follows:—"We note you mention in your issue of this week Major F. Willey's generosity in providing electric light for Blyth Church. This installation, both at the hall and the church was put in by ourselves, and we think that it may claim to be perhaps one of the most extreme combinations of ancient and modern in the kingdom as the church itself was built in the year 1080, and is a remarkably fine specimen of Norman architecture. Can any of your readers quote a better instance of 19th century progress in combination with the 11th century?"

**The City Electrical Inspector's Expenses.**—The Court of Common Council has decided to take no further action at present in regard to the recovery of the expenses of the electrical inspector from the City of London Electric Lighting Company. This matter, our readers will remember, has recently been contested in the Law Courts.

**Copper.**—Messrs. H. R. Merton & Co.'s latest statistics of copper show that on July 15th, 1898, the stocks in England and France comprised 15,925 tons Chili bars, also 326 tons of Chili ingots, 123 tons of Chili ores and Regulus (fine), and 4,464 tons of other stuff (fine) at Liverpool and Swansea. At London there were 1,515 tons including that in process of landing. Other quantities of fine copper in France total 2,492 tons. With advices from Chili and Australia showing another 3,850 tons, this works out at a grand total of 28,695 tons, as compared with 27,355 on June 15th. The price of G.M.B.'s and standard copper was £50 on July 15th, against £50 5s. on June 15th.

**Dissolution of Partnership.**—Messrs. W. Morris and R. Lewis Jones, carrying on business as R. L. Jones & Co., electrical engineers, at 39, Hall Street, St. Helen's, have dissolved partnership by mutual consent. Debts will be attended to by Mr. Morris.

**Electric Canal Haulage in Belgium.**—It is reported that it has been decided to adopt a system of electric haulage on the canal between Charleroi and Brussels.

**Electric Driving.**—The Hebden Bridge Industrial Society have augmented their electric plant by putting down a motor, which will be used for cutting leather, cleaning currants, grinding coffee, &c.

**Electrical Engineering in Germany.**—Under the auspices of Messrs. Schuckert & Co., of Nuremberg, a company has just been formed in Dresden, with a capital of £300,000, to be known as Die Electro Gesellschaft, to establish electric lighting and tramway plants in Prussian, Silesia, Saxony, and the Thuringian States.

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**Electrical Enterprise in Belgium.**—The Brussels correspondent of the *Financial News* says that a new concern, under the name of the Compagnie Electrique Anversoise, has been formed at Antwerp, with a capital of 4,400,000 frs., after having secured from that city the concession for supplying the electric light for public purposes and to private consumers. Amongst the founders are the Société Générale pour Favoriser l'Industrie Nationale of Brussels, the Schaafhausen Bankverein of Cologne, and the Continental Company for Electrical Enterprises of Nurnberg.

**General Electric Company v. Curtis.**—At the Glasgow Appeal Court last week this case was heard. The parties had dealings, and on an accounting the defender admitted being due a certain sum, £24 10s. 8d. The pursuers moved for interim decree for that sum, insisting, however, on proceeding with their case for the balance which they alleged to be due. The defender contended that the pursuers were not entitled to interim decree, as it would place him at a disadvantage. The Sheriff Substitute Guthrie, however, gave decree for the admitted sum, and fixed a diet of proof. On appeal the Sheriff adhered. Agent for pursuers, Mr. George Jeffray. Agent for defender, Mr. Walter Oswald.

**General Power Distributing Company's Bill.**—On the motion for the second reading of this Bill in the House of Commons on Thursday night last week, Mr. J. W. Lowther moved as an amendment, says the *Times* report, that the promoters of the Bill should have leave to suspend any further proceedings thereon, in order to proceed with the same Bill, if they should think fit, in the next Session of Parliament; and that all petitions presented in the present Session against such Bill, within the time prescribed by the rules and orders of the House, and which stood referred to the committee on such Bill, should stand referred to the committee on the same Bill in the next Session of Parliament. In asking the House to adopt this amendment he was taking a somewhat unusual course, though one that was not wholly unprecedented, but which was justified by the quite exceptional circumstances under which the Bill came before the House at this late period of the Session. At the beginning of the Session there were other Bills with this which raised the same new principles; and, therefore, at the instigation of the Chairman of Committees in the House of Lords, a joint committee of the two Houses, known as the Electrical Energy and Generating Stations Supply Committee, was appointed to inquire into the matter. The committee did not report until June; and, in the meantime, this Bill was hung up. After the committee reported, the promoters of the Bill pushed the measure forward. It passed through all the stages of the House of Lords, and it now came before the House of Commons at a very late period of the Session. Therefore, even if the House were to assent to the second reading, it would not be possible to send a Bill of such magnitude, and a Bill also which was so strongly opposed, to a committee in August. Under the circumstances, and seeing that the delay was due, not to the promoters of the Bill, but to the action of Parliament, it was only fair that the promoters should not be at the loss of the costs they had incurred this Session, but that next Session the Bill should be taken up at the point which it had now reached. What he had said in regard to the promoters also held good in regard to the opponents of the measure.

Mr. Mellor hoped the House would assent to the very reasonable motion of the Chairman of Committees. It was most desirable that the House should save the costs of promoters of private Bills as much as possible. Indeed, he thought there ought to be some inquiry instituted with a view to seeing whether those costs could not be substantially reduced.

Mr. Stuart Wortley said it was a matter of common knowledge that this Bill had met with opposition of great magnitude and not less weight. But, in the circumstances, those who took part in that opposition on behalf of certain municipalities did not propose to dispute the motion of the Chairman of Committees, though they believed they could have defeated the second reading of the Bill if it went to a division.

Mr. Stuart said he also entirely objected to the Bill, but the proposal of the right hon. gentleman seemed so reasonable and fair that he would support it. Whatever might be the view of the Bill itself, everyone would be desirous of doing fairly to all the parties concerned, and it was in accordance with the justice of the case that the motion should be passed.

Mr. Bryce expressed great satisfaction at the acceptance of the motion by the hon. member for Sheffield and the hon. member for Shoreditch. The Bill required fuller consideration than the House could give to it this Session.

Mr. J. Lowther said that when he first heard of this motion he feared that it might draw the House into creating an undesirable precedent for the hanging up of public Bills. But the explanation of the Chairman of Committees had made it clear that no such danger was to be apprehended.

Mr. T. Bayley also expressed his concurrence in the motion.

The motion of the Chairman of Committees was then agreed to.

Mr. J. W. Lowther moved: "That this be a standing order of the House." He said that such a motion was necessary in order that the House might have cognisance next Session of the decision just arrived at. The standing order would apply only in this case.

The motion was agreed to.

Last week the Glasgow and various other municipal authorities discussed the above Bill, and resolved to oppose it before Parliament. As the Bill is now to wait over until next session, we suppose the municipalities will let the matter rest for the present.

**"Illustrations of Electric Traction."**—The great extent to which the Thomson-Houston Companies have been identified with the development of electric traction in this country and on the Continent is clearly seen from a beautifully prepared book of "Illustrations of Electric Traction," which has just been issued by the British Thomson-Houston Company. Among the large number of photographs reproduced are views of the power plant and outside work, showing cars in operation, of such well-known instances of overhead trolley construction as the Bristol, Dover, Dublin, Paris, Versailles, Lyons, Rouen, Brussels, Hamburg, Munich, Rome, and a variety of other lines equipped on the Thomson-Houston system.

**Liquidation Notice.**—Creditors of the Mechanical Traction Syndicate should send particulars of their debts to Mr. Vibert Collinson, 6, East India Avenue, E.C., liquidator, on or before August 23rd.

**The London Electric Supply Corporation.**—On Wednesday, before Mr. Justice Wright, sitting as an additional judge of the Chancery Division, Mr. Butcher, Q.C., M.P., on behalf of the London Electric Supply Corporation applied to his Lordship to sanction a reduction of the capital of the company by writing off £2 per share, thus reducing it from £1,250,000 to £750,000. In the course of the proceedings his Lordship asked if this was a going concern?—Mr. Butcher: Oh yes, the company is a going concern and a very prosperous one too.—His Lordship granted the application.

**A Maxim Incandescent Lamp Company.**—According to the daily press a syndicate company has been formed, with a capital of £10,000, for acquiring a contract for purchasing all the rights throughout the world of a new incandescent lamp invented by Mr. Hiram S Maxim. The first directors are: Mr. Hiram S. Maxim, Mr. Jules de Meray, and Mr. F. A. English. It is understood that probably Sir William Crookes will join the board. The special feature of the invention may, in general terms, be said to be the employment of a new description of a filament which, it is claimed, affords a brilliant white light, and is far more lasting than that at present used, with the benefit either of saving of cost from having the same amount of light as at present, with 25 to 30 per cent. less current, or the same cost and a better light. It is said that the syndicate is doubtless the precursor to a larger parent undertaking.

**Miell v. Shrimpton.**—At the Lord Mayor's Court, on Wednesday last week, Sir Charles Hall and a special jury heard the case of Miell *v.* Shrimpton, in which plaintiff, a Lombard Street financial agent and broker, claimed from defendant a sum of £1,875 on an assignment by one Colonel Marshall of an interest in a commission note dated May 7th, 1896 The commission note was in reference to the Brockie-Pell Arc Lamp Company. It was in consideration for an introduction to a firm who were to find capital for the company. Marshall made the assignment to the plaintiff on December 18th. After hearing the case at some length, the Recorder delivered judgement, and said that, in order that the plaintiff should succeed upon the commission note, he must show that the money had been earned. He considered that the plaintiff was only entitled to be paid commission in respect of amounts actually underwritten. He therefore gave judgment for the defendant, who would be allowed costs subsequent to the date of the payment of the sum of £81 into Court. The plaintiff would be entitled to the £81, which it was admitted was due to him. Upon the application of defendant's counsel, it was ordered that the sum of £81 should remain in Court until after taxation, and leave to appeal was given.

**The Shannon Power Scheme.**—The Shannon Fishery Proprietors last week resolved to oppose the scheme of the Shannon Electric Syndicate Company, as the effect of the proposed works was considered disastrous to the interests of the fisheries.

**Smoke Nuisance.**—The Great Eastern Railway were summoned at the Worship Street Police Court last week for creating a smoke nuisance at their electric lighting works at High Street, Shoreditch. The magistrate made an order that it be abated forthwith. Notice of appeal was given.

**Strike.**—The daily papers say that the employés at the Tudor Accumulator Company's Electrical Works at Dukinfield have struck against a reduction of wages on the introduction of improved machinery.

**Winding up Petitions.**—A petition for the winding up of the London Provincial Electricity Company, presented by Mr. Octave de la Chapelle, of Suffolk House, Laurence Pountney Hill, E.C., solicitor, a creditor of the company, is to be heard before Mr. Justice Wright on August 3rd. A similar petition presented by Mr. Robert Stanton, 73, Shoe Lane, E C, metal merchant, for the winding up of the Cox Taermo-Electric Co., will be heard in the same Court on the same day.

## ELECTRIC LIGHTING NOTES.

**Aberdeen.**—The Aberdeen Harbour Commissioners are introducing an electric installation for the lighting of the docks, harbour, workshops, offices, &c. An experiment was made with the new illuminant on one of the quays this week, but some time must elapse before the installation is complete. The necessary electric supply will meantime be taken from the City Corporation mains.

The Town Council, also the Glasgow Council, intend filing opposition to the General Power Distribution Company's Bill.

**Arbroath.**—The Corporation will oppose the application of an electric supply company for a provisional electric lighting order.

**Bethnal Green.**—At a recent meeting of the Board of Guardians the Infirmary Committee reported:—(*a*) Messrs. Calvert and Co. had declined to approve of the draft contract submitted to them, and had intimated that their tender must be accepted as it stands; (*b*) that if their tender were accepted as it stood, there would be no limit to the amount which could be claimed for extras; (*c*) the Committee, under these circumstances, therefore instructed the clerk to inform Messrs. Calvert & Co. that, unless they heard from them to the effect that they were prepared to do the work in accordance with the specifications prepared by Messrs. Owen, Lucas & Pyke, without any reservation whatever, the Committee would recommend the board to provisionally accept the next lowest tender. The Committee were informed by Mr. Pyke that all the contractors were informed, before sending in their tenders, that the maximum horse-power required for driving the machinery could not be included in the specification, because the buildings were not then sufficiently advanced to enable the calculation to be made, hence there is no need for any reservation being included in any tender. The report was adopted.

**Birmingham.**—It is understood that the lighting by electricity of the Council House and the Reference Library is in contemplation by the Corporation.

**Blackpool.**—Last week the General Purposes Committee had a discussion regarding the proposed lighting of Dickson and Warbrick Roads by electricity instead of gas. Mr. Qain said to light up the whole roads with electricity by 1,000 candle-power lamps would cost about £250. If they wanted no better light than they had at present, he could supply it by electricity quite as cheaply as the gas. It was agreed that the Electric Lighting and Tramways Committee be empowered to submit a scheme as to the candle-power of the lights, &c., to a future meeting.

**Bolton.**—The Town Council have resolved upon extensions of the electric lighting installation at a cost of £38,406.

**Bournemouth.**—Messrs. Fippard & Cooper, of Bournemouth, are putting down an oil engine and dynamo for lighting Chaddesley Glen, Canford Cliffs, Bournemouth.

**Bradford.**—The new shilling-in-the-slot meter of the Penny-in-the-Slot Electric Supply Company, was exhibited before the Gas and Electricity Supply Committee of the Council on 22nd inst. The Committee decided to adopt it for use among consumers.

**Bristol.**—Efforts are being made in order that by the time of the visit of the British Association to Bristol a considerable addition will have been made to the street lighting by electricity. For several months past preparations have been in progress at the electricity station for supplying current for the extended mains. The capacity of the engine room has been more than doubled, and the number of Lancashire boilers has been increased from seven to 12. In the course of a few months, according to a Bristol paper, there will be machinery of between 4,000 and 5,000 H.P. in the engine room.

**Bury St. Edmunds.**—A Local Government inquiry has been held regarding the application to borrow £20,000 for carrying out the proposed scheme. The Corporation first took the matter up about two years ago, and, after a good deal of opposition, the supporters of the scheme carried their proposal by a large majority, a provisional order being obtained. Meantime, about half a dozen energetic and leading tradesmen have taken the matter in hand for themselves, and have, either jointly or individually, lighted their premises by electricity. Mr. Medhurst was engaged by the Town Council at the outset, and was entrusted with the preparation of plans and specifications. He estimates that the £20,000 asked for will fully cover the cost of the proposed scheme. Supporters and opponents put their views before the Local Government Board Inspector on 20th inst.

**Cardiff.**—At last week's meeting of the Electric Lighting Committee, tenders were presented for one 300-kilowatt steam alternator and two steam boilers. The electrical engineer (Mr. N. Applebee) presented a report on the various offers, in which he stated that it was not, in his opinion, desirable that the work should be entrusted to a firm named, as a machine which they had contracted to supply in five months was now, after a lapse of two years and three months, still in such a state that he had not finally accepted it. He recommended that the alternator should be obtained from another firm, which complied with the specification on all important points, and the makers guaranteed that it would stand being overloaded 50 per cent. for two hours. The first-named firm offered a duplicate of the plant still unpassed and now at the Corporation works. Councillor Hallet described the second firm as being experimental makers of such plant as was required, and said they had never constructed such a large alternator, condemned certain details in construction, and emphasised the importance of giving the contract to the first parties, whom he characterised as the finest makers of electrical plant in Great Britain. In reply to Councillor Fox, the engineer stated that the machine which was so long overdue was still being experimented with by the makers, and referred to a recent trial as being extremely unsatisfactory. In the face of this divergence of opinion, it was decided, on the proposition of Councillor William Evans, seconded by Alderman Sanders, that the matter should be deferred until further information respecting the experiences of other municipalities with the plant of the two firms named could be obtained. Councillor Fox gave notice of his intention to press for the imposition of the full penalties against the first firm for non-compliance with their present contract. Councillor Fox considered they were placing their official in an invidious position, and ridiculed the idea of wasting time in seeking information about the first firm's engines in other parts of the country when they had their own experience to go upon.

The Corporation Electrical Department is making reductions in the charges for current from July 1st on a sliding scale.

**Cape Town.**—By the last mail we learn that cables are being laid between Cape Town and Wynberg stations for the purpose of providing all the suburban stations with electric light. Valkenberg Asylum is to be lighted from Mowbray, and the Cape Town railway generating station will supply the power for the whole system.

**Cape Town and Suburban Electric Lighting Company.**—At the annual meeting of this company the directors submitted a report, which was adopted, recommending a dividend of 6 per cent., and that the balance be carried forward to the next account.

**Chester.**—The Lighting Committee is to extend the electric lighting mains from the Liverpool Road to Brook Lane railway bridge, for supply of public and private lighting (cost, £227 odd).

The Town Council has decided to request the local member to oppose the General Power Distributing Company Bill in Parliament. It is argued that local authorities should have command of their own districts.

**Cleckheaton.**—The District Council has received notice from the Electrical Power Distribution Company, London, of intention to apply for a provisional order. The matter is referred to the General Purposes Committee. It is thought that the application might be detrimental to the interests of the Council as owners of the gas works.

**Colwyn Bay.**—The Local Government Board has written sanctioning the borrowing of £1,564 for the electric light works, repayable in 25 years. The letter suggested that the machinery at the generating station should be duplicated at the end of one year.

**Cricklewood.**—The Hendon District Council has resolved to apply for a provisional order for supplying their district with electric light.

**Dumfries.**—The Town Council has decided to oppose an application by the Urban Electric Supply Company for a provisional order. The authorities intend at no distant date to take the matter in hand themselves. Several private firms in the town and district have introduced the electric light, and an installation has been put into the Crichton Royal Institution at a cost of no less a sum than £10,000.

**Ealing.**—After going into the matter of free wiring, the Electric Lighting Committee has adjourned its consideration for the present. The Council has agreed to advance the money to cover the cost of wiring the premises of the Ealing Constitutional Club, and to supply current on special terms.

**Edinburgh.**—The Electric Lighting Committee last week fixed their estimate for electric lighting in the city for the year from May 15th, 1898, at £31,820, as compared with an estimate last year of £21,165, and an actual expenditure of £24,444. The revenue on account of the expenditure was estimated at £51,250, as compared with an estimate last year of £35,455, and an actual revenue of £38,049. For capital expenditure they estimate a sum of £130,500.

**Elham.**—The Cheriton surveyor recommends the Council to oppose the application of a company for a provisional order.

**Exeter.**—Last week the Electric Lighting Committee reported that Messrs. Hind & Robinson, London, solicitors, had written on behalf of Mr. M. D. Rucker, with reference to an alleged infringement of letters patent granted to William Phillips Thompson in the year 1835, for improvements in distributing electricity and apparatus therefore, and demanding payment of damages for the past user, and an undertaking to cease to use the same in future until a license had been obtained from him, which license he was willing to grant on reasonable terms. The Town Clerk had at once written to Messrs. Hind & Robinson, asking to be informed in what manner the Council were infringing the patent. The report was adopted.

The Electric Lighting Committee has given instructions for consideration to be given to the best means of overcoming the smoke nuisance.

**Fleet (Hants).**—Mr. Warden-Stevens has been retained to act as consulting engineer for an electric lighting scheme.

**Great Yarmouth.**—The Town Council having decided to borrow for extension of their electric lighting system a further sum of £4,800, making £38,800 in all, a Local Government Board inquiry was held on Friday last by H. P. Boulnois, Esq., M.I.C.E. It was stated by the borough surveyor, on behalf of the Corporation, that during the four years the electric light had been installed in Yarmouth the town had made remarkable progress, and the value of property generally had increased by 40 per cent. The number of private electric lamps now supplied was 13,290. Cables now in use had been so during the four years, and showed no trace of deterioration. The amount to be borrowed was required to meet the increasing demands of private customers. For additional arc lighting

in public streets, another loan would be required. The surveyor stated that, taking into account the payment of interest on loans and repayment of capital, there had been a deficit of £700 a year for two years, but the financial position had improved so much that he anticipated the revenue for 1898 would be sufficient to meet every outgoing, and that in the near future a substantial profit would be realised.

**Greenock.**—The North British Electricity Supply Company has renewed its application—which was successfully opposed by the Councils of Greenock, Port Glasgow, and Gourock last year—for a provisional order for the district.

**Hanley.**—The Council is to raise various sums for local objects, including £14,880 for additional machinery at the electricity works.

**Harrogate.**—The Gas and Electric Lighting Committee having considered the report of the engineer as to the street arc lighting scheme, proposed that he be instructed to erect in West Park five pairs of poles complete with suspenders, wires and gears, and upon these to fix various samples of lamps for an extended test and public trial under actual working conditions. The Council has decided that the electrical engineer fix up one set of the sample lights and three ordinary pillar lights.

On Saturday last a special military band fête was held at the Spa, Harrogate, to inaugurate the ornamental lighting by electricity of the extensive grounds attached to the estate.

**Heaton Norris.**—At the last meeting of the District Council Mr. Barton announced that arrangements had been entered into with the Manchester Corporation to supply the district with electricity both for electric traction in connection with the tramways and for street lighting. The supply would cost them no more than it cost consumers in the city. Before long, therefore, they might expect to see the district lighted by electricity.

**Heckmondwike.**—Some days ago a representative from Messrs. Foote & Milne, electricians, London, who desire to acquire the power to supply Heckmondwike with electricity, had an interview with the District Council. Messrs. Foote & Milne have estimated that a private demand of about 1,250 16-C.P. lights might reasonably be expected, and assuming that the Council will go in for street lighting, have estimated for the installation of 32 arc lamps, consuming ½ unit per hour. They would, in the first place, instal three sets of engines and dynamos, any two of which would provide the anticipated demand, *i.e.*, 72 kw. Two sets of boilers would be provided, either of which would be capable of steaming at full load the two engines in use. The system of distribution to be employed would be the three-wire system, with 400 volts between the outers. Underground cables would be used throughout. The firm add:—"The two proposals which we are prepared to submit to your Council are as follows: (1) That we take over your provisional order in the terms of our letter of March 22nd, undertaking to give such securities as may seem necessary for the fulfilment of the conditions of the provisional order within the period of one year. For the purpose of erecting a central station, we would suggest our renting from the Council the piece of land situated at the junction of Oldfield Street and High Street, at a rental of, say, £15 per annum. The price to be charged for private lighting to be a maximum of 7d. a unit, with rebates to consumers for long hours running, and a minimum of 4½d. per unit. The price to be charged for public lighting to be 4d. per unit, plus a sum of £25 per annum for maintenance of the arc lamps. (2) Or we would be prepared to erect and equip the station and lighting as herein described, and to provide house connections and meters to the number of 40 for the sum of £5,800. Further, we would undertake the whole of the costs of running the station and supplying electricity at a charge to the Council of 3d. per unit, provided that the minimum annual charge should be not less than £500. It has occurred to us that, if your Council contemplate erecting a central station on their own account, this second proposition might be acceptable, as it would ensure the plant being put down in such a way as to give the most economical results in working." The representative of the company answered numerous questions addressed to him by the members of the Council, and undertook to supply a copy of the statistics he submitted, and other information.

**High Wycombe.**—The Electric Lighting Company has applied for the repayment of £3,000 of the £5,000 deposited by it at the London and County Bank as surety for the proper execution of the undertaking. This has been agreed to by the Council.

**Huddersfield.**—The Electric Lighting Committee has reported that the number of consumers for July was 698, as compared with 685 in June, and the lamps connected 46,857, as compared with 46,014; and the units metered 27,019, as compared with 14,929. For the half-year the figures are—July, 698; January, 598; lamps 46,857 and 41,702; and the units metred 292,654, as against 192,707. It has been resolved to take up £6,000 on loan from the borough fund. The Local Government Board has sanctioned the borrowing of £5,000 for the erection of buildings for the purposes of electric lighting. It has been determined to extend the mains to Longroyd Bridge. The Committee are to consider the question of charges for electric energy for trade purposes, and report.—The Corporation on 20th inst. approved the recommendation of the Electric Lighting Committee that £6,000 be taken up on loan from the borough fund for extension works, and that the supply be extended to Longroyd Bridge, Huddersfield.

**Inverness.**—The Town Council has resolved to obtain a report as to the best method of introducing the electric light into Inverness, and at what cost it could be supplied to the public. Provost M'Bean stated that many firms and public buildings in Inverness had already introduced the electric light, and judging from that fact he was convinced it would be well received. £50 is to be spent upon the inquiries.

**Ipswich.**—The Board of Guardians had the question of the electric lighting of the workhouse before them some days ago. The Workhouse Erection Committee had instructed Mr. Dalby to alter the original specification so as to make it in accordance with Messrs. Crompton & Co.'s tender to carry out the electric installation, exclusive of the motor power, for £1,650, and to prepare a specification for the supplying of the necessary 32 H.P. gas engine by the Ipswich Gas Company, including laying the main, for £400. The Committee also recommended that the laundry machine should be driven by an electric motor, and that Mr. Dalby obtain a tender for the same, with all necessary fittings, from Messrs. Crompton & Co. The Guardians approved of the recommendations.

**Keynsham.**—The Parish Council last week considered the question of lighting. The clerk stated that advertisements had been inserted asking for tenders, and it was agreed that the tender from the Keynsham and West of England Electric Works at £161 15s. be accepted.

**Kingswood.**—Messrs. Parfitt & Son are still asking, on behalf of the Western Counties Electric Lighting Company, when the Kingswood Council are likely to conclude the contract for the purchase of their undertaking. The Finance Committee will consider the matter.

**Lambeth.**—The proceedings at the ordinary meeting of the Lambeth Vestry last week were remarkable from the sensation produced on the presentation by the Finance Committee of copies of the accounts of the South London Electric Supply Corporation up to December 31st, 1897, as audited by the Board of Trade. The Finance Committee in submitting the accounts, recommended the Vestry to request the Board of Trade to hold an official inquiry into the circumstances of the transfer of the Vestry's order to Mr. Sax, and into the means employed to secure that transfer. Mr. Wightman, who moved the recommendation, agreed to the addition of the Local Government Board, or some other competent authority as suggested by Mr. Cooper, as an alternative to the Board of Trade. As a reason for this course, it was freely stated that vestrymen had been bribed to the extent of £1,000 in order to secure the transfer of the provisional order, and that the question should be probed to the bottom. After an exciting discussion, the recommendation was unanimously adopted.

**Leicester.**—The Gas and Electric Lighting Committee report that the total output of electric current from the central station for the half-year ending June 30th last was 224,642 units, as against 145,341 units in the corresponding period of last year, being an increase of 79,301 units. The number of consumers was 398.

**Lewisham.**—The District Board of Works will hold a special meeting on September 21st to discuss the matter of the provisional order applied for by it.

**Lincoln.**—At a special meeting of the Town Council last week Alderman Page (the Mayor) delivered a speech dealing with the proposed scheme of the General Power Distributing Company and its probable effect upon Lincoln. A petition against the Bill was approved by the Council.

**Llandrindod Wells.**—The District Council recently had a discussion *re* the proposals of the Electric Light Company in regard to the erection and equipment of their boiler house. The necessity for precautions to be taken to prevent smoke nuisance were particularly mentioned. The Council approved the plans with a shaft 70 feet high.

**Llanelly.**—It has been decided to make an installation of electric light at the extensive brewery of Messrs. Buckley Bros., Limited, in Llanelly, Carmarthenshire. Tenders will, in due course, be invited for the work.

**London, E.C.**—The new branch of the London and Westminster Bank, Limited, which is now being built at the corner of Old Street and City Road is to be fitted throughout with electric light. Mr. Whitney, of 117, City Road, has the contract.

**Macroom.**—Mr. Thierman, the electrical engineer who has charge of the electric lighting undertaking, has lately visited Macroom in connection with the matter, and a contract for opening up the streets for the cables has been passed at the assizes in Cork. It is expected that the work will be completed by the end of October.

**Marylebone.**—At last week's Vestry meeting a good deal was said about the rejection of the Vestry's application for a provisional order. Mr. Brooke-Hitching said that because the Vestry had failed on this occasion it was not to say that they would fail on subsequent occasions. They might, in the near future, get members in the House who had sympathy with the aspirations of municipalities. The Electric Lighting Committee had done their best to obtain a very valuable right, in the aspirations of which they were seconded by the officials of the Board of Trade, who gave them the order conditionally on it being confirmed by Parliament. The second reading of the Bill was carried by a majority amounting to two to one. Although the Vestry had failed to obtain what they desired, he hoped they would ultimately acquire a municipal electric supply. There were the possibilities of purchasing the undertaking of the company in Marylebone on reasonable and proper terms. Unless the Vestry undertook the lighting of the streets, they would remain badly lighted. After some discussion the matter was referred to Committee.

**Marylebone.**—The Board of Guardians have decided to light the board room and the offices by electricity in accordance with the specification prepared by the clerk of works, at a cost of about £100. Tenders are to be asked from the following firms in the neighbourhood, *i.e.*, Emanuel & Sons, Benham & Sons, Faraday and Sons, and Veritys, Limited.

**Newbury.**—It was stated at a recent meeting of the Corporation that there was a probability of the electric light being introduced into the town, and the Council were advised to reduce the price of gas to 3s. 6d. per 1,000 feet to compete with it. The Corporation are the owners of the gas works, and sometime since obtained an electric lighting provisional order to prevent a company introducing the light, but nothing was done. It is now understood that a local syndicate is willing to purchase the order and supply the light.

**Paddington.**—The Vestry Electric Lighting Committee is to consider the advisability of applying for a provisional electric lighting order.

**Paisley.**—The Electric Lighting Committee have agreed to recommend the Town Council to borrow a further £25,000 for the extension of the electric lighting system, according to Mr. Teague's estimate. This makes the total sum borrowed up to the present in connection with the electric lighting £60,000.

**Peterborough.**—Mr. J. C. Gill, the borough engineer, is to proceed with the plans for the electric light station to be erected in Albert Place. Mr. Gill is to confer with Dr. Fleming, whose fee has been fixed at 200 guineas.

**Provisional Orders.**—The Margam and Bridgwater District Councils' provisional orders were before the House of Commons Committee on Unopposed Bills last week, and confirmed. The Perth provisional passed for third reading last week. The West Bromwich order was also confirmed.

**Rotherhithe.**—The Vestry has accepted the tender of Messrs. J. H. Pickup & Co. (£178) for installing the electric light in the large hall. It has also arranged with the London Electric Supply Corporation to bring a main along Lower Road to the Town Hall.

**Rowley Regis.**—The Midland Electric Corporation for Power Distribution, Limited, have given notice of intention to apply to the Board of Trade for a provisional order to be confirmed in the next session of Parliament, to supply electricity within this and other districts.

**Salford.**—A Local Government Board inquiry was held yesterday into the Council's application to borrow £33,000 for electric lighting purposes.

**Saltburn.**—The ratepayers have voted on the electric lighting question, and the majority are opposed to the Urban Council obtaining a provisional order, therefore the Council has arranged to let the matter drop. Whether the Council will still oppose the scheme of the Assets Company remains to be seen.

**Southampton.**—At the last meeting of the Town Council, a special committee appointed, *re* the Workmen's Compensation Act, 1897, reported that they had considered the subject of insuring the employés of the Corporation against the provisions of the Act. The Town Clerk having submitted the offers received from various insurance offices, it was resolved to obtain quotations for the insurance of the employés engaged in the electric light department only, the acceptance of a quotation to be left with the Town Clerk and electrical engineer. The consideration of the subject of insuring the employés in the other departments was left over for the present.

**Stirling.**—Some time ago the Stirling Police Commissioners applied to the Waterworks Commissioners for permission to utilise the water supply at Touch for the production of electric energy for the lighting of the town, if the scheme submitted by Mr. Yorke was considered feasible. The Waterworks Commissioners remitted to Mr. Wilson, C.E., Edinburgh, to report upon the application, and his report was submitted to a recent meeting. Mr. Wilson finds that the amount of available power is so small in proportion to the amount that would be required for the lighting of the town that he does not think the Waterworks Commissioners would be wise in restricting their control of the water works for the sake of getting this power for electric lighting, and as the use of the water in this way might lead to complications between the Commissioners and the proprietor. The Police Commissioners held a meeting on 22nd inst. for the purpose of considering the matter. The Board of Trade reported that they saw no reason to object to the scheme detailed in Mr. Yorke's report. Mr. Yellowlees criticised Mr. Wilson's report to the Water Commissioners. It was agreed by a majority to remit the letters to the Lighting Committee to consider and report.

**St. James's, Westminster.**—The Vestry has received a letter from the St. James's and Pall Mall Electric Lighting Company, stating, with reference to the company's charges for the supply of electricity in the parish, that they regretted that they were not in a position at the moment to re-open the question, but were prepared to give the views of the Vestry full consideration in arranging their charges for the ensuing year. The company suggested that the views of the Vestry would be met by bringing the question, in a friendly way, before the Board of Trade, with a request that the Board should see a representative of the Vestry and the company and advise generally.

**Stonehouse.**—The Stonehouse Electric Lighting Provisional Order Bill was before the Select Committee on Unopposed Bills last week.

**Stourbridge.**—The Council will oppose the application of the Midland Electric Corporation for Power Distribution, and will itself apply for a provisional order. The Council has given the British Electric Traction Company permission to erect poles in connection with the conversion of the existing tramlines to electric traction.

**Theatre Lighting.**—The new Princess's Theatre, Kennington, of which the foundation stone was laid on Monday by Sir Henry Irving, and the new Empire Theatre, Bradford, are to be lit by electricity, each installation consisting of about 1,200 lights. Complete plant for generating the current will be put in at the former, while it is proposed to light the latter from the Bradford Corporation's mains. Messrs. Owen Lucas & Pyke are preparing the specifications.

**Trowbridge.**—The Trowbridge Urban Council have decided to oppose the application of a London electricity company for powers to supply the district with electricity.

**Wakefield.**—From a debate which took place at a recent Council meeting, it seems that two assistant electrical engineers have been appointed for the electric light station without the knowledge of the Council, or without their being advertised for in the usual way. It was not clear, from a report of the discussion that we have seen, that even the Electric Light Committee was aware of the appointments being made. One speaker said that the Committee told the engineer to look out for two men, but the matter should have gone before the Committee before they were actually appointed.

**Whitechapel.**—It is suggested that the Electric Lighting Committee to be appointed shall be a standing Committee, and consist of 25 members. The District Board of Works will consider the matter at its next meeting.

**Windsor.**—The Windsor Electrical Installation Company have just placed in position an additional new boiler, 14 feet in length and 8 feet in diameter, in their central station in Peascod Street. The boiler is of the "Economic" type and tubular. The company now supply 7,000 lights in Windsor and Eton, besides four electric motors, and two arc lights in Thames Street.

**Woking.**—The local tradesmen have been asking for reductions in the price per unit. The Electric Light Company has given all customers a scale of discounts, but has explained the various reasons which prevent a lower unit charge at present. The Company refers to the high price of coal delivered at Woking, the scattered nature of the district supplied, &c.

**Worsbro'.**—The Worsbro' District Council has resolved to ask the Barrow Company if they are prepared to entertain the idea of lighting the township with electric light.

## ELECTRIC TRACTION AND MOTIVE POWER NOTES.

**Aberdeen.**—The Corporation of Aberdeen, who have just obtained control of the city tramways are, as already stated, contemplating the introduction of electric traction in the future development of the system. In some districts of the city where tramway extension is called for, the gradients are so steep that electric haulage is deemed the only feasible method of supplying the desired facilities.

**Chatham.**—On Tuesday next the Light Railway Commissioners will hold a public inquiry at the Sun Hotel, for the purpose of receiving information to guide them as to the expediency of granting the application which has been made to them by the Rochester, Chatham, Gillingham and District Electric Railway Company, Limited, for an order to authorise their proposed light railway.

**Colombo.**—The *Ceylon Standard* says that the first of the electric tramcars was fitted up on 5th inst. at the central power station in Gas Works Street. The car is divided into first and second class compartments.

**Cork.**—At the Incorporated Association of Municipal and County Engineers, Cork district meeting, on Friday, August 5th, among others a paper will be read on "Description of Cork Electric Tramways," by Mr. Bevily Griffin, A.M.I.C.E., resident engineer for the contractor for permanent way. In the afternoon a visit will be paid to the Electric Tramway and Lighting Company's central station.

**Bradford.**—On 20th inst. Major Cardew made a Board of Trade inspection of the new electric tramways on the Bolton Road, which we describe in another part of this issue. He was accompanied by the chairman of the Tramways Committee (Alderman Cowgill) and several officials. Ultimately Major Cardew expressed himself very satisfied with the line. During the early hours of the following morning an extensive trial was made of the working of the cars. The current was turned on at about midnight, and Mr. M. A. Requier, electrical engineer for the Westinghouse Electric Company, Limited, made a journey from the Bolton Road depôt to Forster Square, where he was met by the chairman of the Tramways

Committee, the city electrical engineer (Mr. Gibbings), the city surveyor (Mr. W. H. Cox), the assistant city surveyor (Mr. W. Dawson), Mr. R. W. Blackwell, and others. Two trips were then made the full length of the line. The formal opening was to be arranged for to-day, and it was hoped that regular running would commence on Bank holiday. The last of the nine cars intended for the Great Horton Road service have reached Bradford. A good deal of work yet remains to be done on the latter line, and it will be probably four or five weeks before the line will be ready for opening. The Tramways Committee has arranged that the new electric cars shall stop at certain definite stations upon the roads to Bolton and Great Horton. In regard to fares these have been fixed as follows:—From Bradford to Horton Bank Top there will be three 1d. stages, but on the return journey the cars will require very little power, and 2d. will be charged for the entire distance. The Committee decided to run workmen's cars.

**Dudley.**—At a special meeting of the Dudley Town Council, on Thursday of last week, the Mayor (Councillor Geo. H. Dunn) presiding, an important report was submitted of a meeting of the Electrical Tramway and Railway Committee. In this report it was stated that the terms come to with the British Electric Traction Company were, that the company shall construct the tramway from Queen's Cross to Mouse Street Brook to the satisfaction of the Corporation; all road work beyond the laying and electrical equipment of the line to be executed by the Corporation at the cost of the promoters; the Corporation to purchase the existing tramways and the new line four years hence at a price to be settled by the Board of Trade, the lines to be leased to the company on terms to be settled by arbitration, the Corporation to supply electrical energy for the said lines at a price to be decided by arbitration. The Committee congratulated the deputation upon the terms they had secured, and recommended the adoption of the agreement. The report, after considerable discussion, was unanimously adopted.

**Durban.**—On June 25th the Town Council decided to buy up the tramway system and equip the lines electrically. The company is to be paid £114,000. As Bills will have to pass Parliament, it is hardly likely that the transfer will be completed until June, 1899.

**Halifax.** — The Tramways Committee held a special meeting last week to consider the question of tramways extensions. A number of extensions were decided upon, to be begun and completed as soon as possible. Powers have been obtained, but the resolution of the Tramways Committee will have to be confirmed by the Town Council. The additional lines will run from Commercial Street to the New Inn, Skircoat Green; from Commercial Street to the Falcon Inn, Salterhebble; from Horton Street, along Market Street, to Boothtown; from King Cross, *viâ* Warley Road, to High-road Well.

**Hanley.**—The promoters of the Potteries Extension Tramways Order, 1896, are asking the Board of Trade to prolong the time limit for completion of the works authorised by such order, until February 7th next. The Hanley Council will make a complaint to the Board of Trade as to the delay in the carrying out of the works.

**Huddersfield.**—Reports of the officials have been considered by the Tramways Committee as to the conversion of the tramways from steam to electricity, and a sub-committee has been appointed to deal with the question. Each member of the Council is to have a copy of the report on the conversion question.

**Ingleton.**—The proposed scheme of an electric tramway on to Ingleboro' has been revived.

**Laxey and Ramsey.**—The new tramway connecting Laxey and Ramsey, and thus making a through line from Douglas to the latter town, is rapidly nearing completion. On Thursday, July 14th, the first car was run over the entire system. The wires not yet being up, the motive power was steam. It is confidently expected that the line will be open for traffic before the end of the month. Col. Rich, Government inspector, inspected the line on July 18th and reported satisfactorily.

**Manchester.**—The Manchester Carriage and Tramways Company's Bill passed the committee stage in the House of Commons last week unopposed. It is stated that the Bill is considerably altered from what it was when it originally came before the House of Lords. It proposed to confer powers for electric traction, but all that part of the measure is deleted, and the Bill simply deals with the consolidation of the company's stock.

**The Metropolitan Railway and Electric Traction.**—The following extract from the report of the Metropolitan Railway Company is of special interest in view of certain unofficial statements which have been made during the past few months:—"The company's Bill of this Session, containing provisions for improving the ventilation of the railway and for working the traffic by electricity, &c., has been passed by Parliament, and the directors, believing that the time has now arrived when electrical traction can be introduced with success and advantage, have agreed with the Metropolitan District Company for an experimental working by electricity of a piece of line on their system between High Street, Kensington, and Earl's Court Stations, at an estimated cost of £20,000, to be borne in equal proportions by the two companies."

**Paisley.**—Last week the Glasgow Council's proposals for extending their tramlines in Paisley Road to the boundary of the Burgh of Paisley were before the Paisley Council, and sub-committees of the two Councils have been conferring. Representatives of the British Electric Traction Company were present at the Council meeting and an exchange of views took place, when it was elicited that the county trustees would require, as a *sine qua non*, that a double line of rails be laid between Ibrox and Paisley and Paisley and Johnstone. The representatives of the company, on the other hand, intimated that they would not agree to this. The meeting was finally adjourned until it can be learned with more certainty what Glasgow Corporation propose.

**Redditch.**—The Warwickshire County Council has resolved to oppose the scheme to construct a light railway along the main road from Redditch to Astwood Bank. Lord Hertford said it was proposed to construct an overhead electric tramway along the centre of a beautiful road. This was the ground for the opposition.

**South Staffordshire.**—A conference of local authorities interested in the future of the South Staffordshire tramways, was held in the West Bromwich Council chamber on Wednesday of last week. The question for consideration was the municipalisation scheme. The conference was presided over by the Mayor of West Bromwich (Councillor S. Pitt), and the authorities represented were, in addition to West Bromwich, the Corporations of Wednesbury and Dudley, and the Urban District Councils of Darlaston, Tipton, and Handsworth. After a lengthened discussion the following resolution was, on the motion of the chairman, seconded by the Mayor of Wednesbury, carried:—"That in the opinion of this conference it is desirable that all the local authorities within the district of the South Staffordshire Tramways Company should take steps with a view to purchasing the tramways within their respective districts, and also to oppose the proposed application to Parliament of the British Electric Traction Company for a Bill to confirm a lease of the tramways to that company, and that a copy of this resolution be sent to each local authority." This decision, it may be stated, was foreshadowed in the Electrical Review of last week. It was stated that the total cost of reconstruction of the lines for the overhead electric system of traction would be £121,476; and in addition the authorities will have to pay to the Tramway Company the value of the whole of the lines.

**Tramway Bills.**—In the House of Commons last week the Lords' amendments to the following private Bills were agreed to:—Blackburn Corporation (Tramways, &c.) Bill, Bristol Tramways (Electrical Power, &c.) Bill, Bristol Tramways (Extensions) Bill.

**Tynemouth.**—At the annual meeting of the North Shields and Tynemouth District Tramways, Limited, held on 22nd inst., the chairman, Mr. Henry Carrick, J.P., in moving the adoption of the directors' report, referred to the proposed introduction of electric trams into the locality. The negotiations between the British Electric Traction Company and the Tynemouth Corporation were still pending, he said, the delay having been caused by the Corporation making it a condition that the electrical energy for the tramways should be purchased from the electric station shortly to be established by the municipal authority. Another serious obstacle raised by the Corporation was the amount of street space to be paved and kept in repair by the company, and, in the interest of the town and district, it was to be hoped that the Corporation would modify their demands, and thus enable the tramways to be extended and electrically equipped throughout.—The report was adopted, and a dividend of 5 per cent. was declared for the year.

## TELEGRAPH AND TELEPHONE NOTES.

**Birmingham Telephones.**—The Birmingham system of the National Telephone Company is undergoing an entire reorganisation. The erection of the new exchange in Newhall Street is now completed, and the work of fitting it up is proceeding rapidly. As the connections have to be transferred to the new building, the opportunity has been taken to reconstruct the telephone system of Birmingham and the neighbourhood. A new switchboard has been put in and the wires have been laid underground.

**Delays on Australian Landlines.**—We have before us a telegram handed in at Albany in Western Australia, just 24 hours before it reached its destination in Sydney, New South Wales. This delay may be partly due to the fact that the Albany office closes at night, but in any case even 12 hours is a very serious delay, and yet we find that no announcement is made of any exceptional cause of delay on the day in question. We can only suppose this to be the normal state of telegraphic affairs, and it is therefore not surprising to read of the general dissatisfaction with the telegraph system which prevails in business circles throughout Australia.

**The Manila Cable.**—A member of the Manila cable staff writes to the *Times* from Manila on June 13th to protest against the statement which appeared in a Reuter telegram reproduced in *The Times Weekly Edition* of May 6th, that "cable communication was interrupted, the operators at the station, which is in the midst of the forts, having fled to save their lives." The writer who, according to the *Times*, seems quite unnecessarily to imagine that this statement, even if it had been accurate, would have reflected on the courage of the cable staff, gives the following interesting account of the facts:—"On the morning of May 1st Cavite was bombarded by the American squadron, and the Spanish fleet was destroyed. During the whole of the action the staff of the cable company, from the superintendent downwards, were at their posts, although their office is situated only 200 yards from a Spanish battery, which several times opened fire on the American ships, which fortunately did not reply. Having completed the destruction

of the Spanish fleet and Cavite Arsenal, the American commodore lined his ships up in front of Manila, with their guns trained on every shore battery, with the evident intention of commencing a bombardment should a single shot be fired on his squadron from any one of the latter. The servants of the cable company were, all this time, in their office, transmitting the telegrams which were handed to them, as if nothing unusual had happened. On the evening of May 2nd the Hong Kong cable became interrupted whilst one of the operators was in the act of receiving a telegram from Hong Kong. Two of the servants of the company immediately proceeded to the cable house on the beach, which is within a stone's throw of the battery, which was still threatened by the American guns, and having set up the testing apparatus, proved to their satisfaction that the cable was broken about 10 miles from the shore. After the interruption of the Hong Kong cable the occupation of the cable company's staff was nearly gone, but they still maintained the telegraphic service to Panay and the neighbouring islands until May 23rd, when the Panay cable was also severed about five miles from Manila, and cable communication thereby entirely cut off. Since that date the Englishmen who have been represented as having fled for their lives on May 1st have been standing by their office day and night, although the building has since the 5th inst. been repeatedly struck and even pierced by bullets from the insurgent forces, who have since that date been maintaining a determined attack on the Spanish entrenchments in the neighbourhood. I do not make these representations in any boastful spirit. The cable staff, of which I am a member, are merely trying to serve their employers' interests to the best of their abilities, and, although they have been given by the directors of the company *carte blanche* to retire to a place of safety, the European members of the staff are still standing to their posts, in the hope of being able to restore cable communication should they be allowed to make the attempt."

**Newington.**—The Electric Lighting Committee, at a meeting held on Wednesday evening last week, recommended, and the Vestry decided, that the National Telephone Company should be permitted to lay in the trenches to be made for the electric light mains, tubes, and telephone cables under the supervision of the consulting engineers, and on condition that the company contributed a moiety of the expense of taking up and replacing the footways and the excavation of the trenches.

**Telegraph Companies' Combination.**—In reference to the proposed more intimate federation of the Brazilian Submarine Telegraph Company and the Western and Brazilian Telegraph Company, Mr. Robert Jackson writes to the financial press as follows:—"It is to be hoped that the shareholders in the Western and Brazilian Telegraph Company, Limited, will not consent to the arrangements with the Brazilian Submarine Telegraph Company as now formulated, the terms for them being wholly insufficient. The proposed arrangement is of itself a sufficient proof of the incapacity of the directors to manage the affairs of the company, as I have, in a humble way, for a long time sought to point out. Under capable management the exchange of shares might be effected on much more advantageous conditions, and it is to be hoped that shareholders will withhold their proxies, and that those who have sent them in will claim their immediate return. There is a suppression of fact of which probably few of the present holders are aware. The ordinary shares of the Western Brazilian are £20 paid, and in the event of the lines being taken by the Brazilian Government, that is the basis on which the company is to be purchased—an important point to be borne in mind by the Western Brazilian shareholders. It is also well to point out that all the present directors are to remain in office for five years, and that no saving in that respect is to be made. The time for the consideration of the proposed amalgamation is altogether too short."

**Telegraphic Interruptions and Repairs:—**

| Cables. | Down. | Repaired. |
|---|---|---|
| Brest-St. Pierre (Anglo, 1869) | April 6th, 1893 .. | ... |
| West Indies— | | |
| St. Croix-Trinidad ... | Nov. 30th, 1896 ... | ... |
| Caimanera-Santiago de Cuba ... ... ... | June 10th, 1898 ... | ... |
| Amazon Company's cable— | | |
| Cable beyond Gurupa ... | June 8th, 1898 ... | ... |
| Cyprus-Latakia ... ... | Feb. 10th, 1898 ... | ... |
| Hong Kong-Manila ... ... | May 3rd, 1898 ... | ... |
| Bolama-Bissao ... ... | July 21st, 1898 ... | ... |
| **Landlines.** | | |
| Trans-Continental line beyond Masol ... ... | March 12th, 1898 . | ... |
| Cartagena-Barranquilla ... | July 4th, 1898 ... | ... |
| Indo-European between Kertsch and Teheran ... | July 22nd, 1898 ... | July 23rd, 1898 |

## CONTRACTS OPEN AND CLOSED.

### OPEN.

**Barking.**—August 10th. The Council wants tenders for the supply and delivery of electric meters and main cut-outs for a period of 12 months, also for the supply of lamp brackets and columns, and for the free wiring of premises in the district. Mr. W. C. C. Hawtayne is consulting engineer. See our "Official Notices" July 22nd and for this week for particulars.

**Belgium.**—August 1st. The municipal authorities of Stavelot are inviting tenders until August 1st for the concession for the supply of electrical engines for lighting and power purposes in the town during a period of 30 years. Tenders to be sent to L'Administration Communale de Stavelot (Belgium). Particulars from the Secretariat de la Ville on payment of 4 francs.

**Hapton.**—August 1st. The Parish Council ask for tenders for lighting the district by electricity to be sent to the clerk.

**Hull.**—August 25th. The Electric Lighting Committee want tenders for the supply and erection of a 750-I.H.P. Willans or Belliss type engine, a 460-kw. high tension continuous current dynamo, and two 30-feet × 8 feet Lancashire boilers, for the electric light works. City electrical engineer, Mr. A. S. Barnard. See our "Official Notices" this week.

**London.**—August 15th. The managers of the Central London Sick Asylum District are inviting tenders for electric lighting plant for the new asylum, Hendon, Middlesex. Specification, &c., from the architects, Messrs. Giles, Gough & Trollope, 38, Craven Street, Charing Cross, W.C. See our "Official Notices" July 22nd for particulars.

**London.**—The Director of Army Contracts is inviting tenders for the supply of various articles from time to time during the next 12 months. Among the items are electrical instruments, India-rubber goods, metals (copper, lead, zinc, tin sheet), telegraph cable and wire. Particulars from the Director, War Office, Pall Mall, S.W.

**Pemberton (Lancashire).**—The Urban District Council ask for schemes for lighting the district by electricity. See our "Official Notices" July 22nd.

**Russia.**—Tenders are being invited until August 13th next by the municipal authorities of Tiflis, for the erection and equipment of a central station for the electric lighting, by means of arc lamps, of the public streets in the centre of the town. Particulars may be obtained from, and tenders to be sent to, La Mairie de Tiflis, Russia.

**Russia.**—M. J. Kobelzky, ingénieur des mines at Kieff (Krechtchatch, 50), Russia, is at present inviting tenders for the construction of an electric railway about 15 kilometres long, between Pirogoff and Kieff. Particulars may be obtained from M. Kobelzky.

**Shanghai.**—August 10th. The Shanghai Municipal Council invites tenders for the supply of two 100-kw. direct coupled steam alternators, switchboard, and water-tube boiler. Particulars and specifications to be obtained from Messrs. John Pook & Co., 8, Jeffreys Square, St. Mary Axe, E.C., to whom tenders have to be sent. See our "Official Notices" June 24th.

**Wigan.**—Tenders are asked for the electric lighting of the Drill Hall on the occasion of the Wigan Trades, Commercial and Art Exhibition to be held from October 26th to December 7th. See our "Official Notices" July 15th.

### CLOSED.

**East Hull.**—The contract for the wiring in connection with the Corporation New Baths, East Hull, has been placed with Messrs. Thompson, Howard & Co., of York.

**Edinburgh.**—Messrs. P. C. Middleton & Co., of Aberdeen, have been entrusted by the Edinburgh Corporation with the electric lighting contract for the City Police Chambers, including the lighting of the Fire Station and Workshops. The number of lights is 450.

**Germany.**—Tenders were recently invited by the State Small Arms Works authorities at Spandau, for the supply of 1,200 16-C.P. 100 to 110-volt incandescent lamps. The lowest offer sent in was that of Messrs. Pintsch Gebrüder, of Berlin, who offered to supply the lamps at 40 pfennig, or about 4½d. each.

**Glasgow.**—The Electricity Sub-Committee has adopted the tender of Arrol's Bridge and Roof Company for the amount of £6,939 16s. 10d for the iron and steel works of the new generating station at Port Dundas, and rejected the offer of Mr. John Mundy for the amount of £6,254. The reason for this was that Mr. Mundy would take nine months, but Arrol's would take four months.

**Hammersmith.**—Messrs. Spencer & Co., have received the Vestry's order (£618) for the supply of pipes required in connection with the electric lighting extensions. Messrs. Marshall, Sons & Co. will supply a new engine for the sum of £760. The engine is to be used as temporary plant pending the erection of machinery now in course of construction. It was supplied to the *Daily Telegraph*, but had not been used.

**Liverpool.**—It is reported that Messrs. W. C. F. Busch and Co., electric tramcar builders, Hamburg, have secured a large order for electric tramcars for Liverpool.

The Special Committee having control of the construction of the Dingle electric trams, have, on the recommendation of Dr. Hopkinson, accepted the tender of the Electric Power Storage Company for the supply of batteries, &c., for the sum of £2,390, with an annual maintenance charge of £136.

## NOTES.

**The Szczepanik Telelectroscope.**—The Szczepanik telelectroscope, an apparatus for transmitting scenes and pictures over a wire, is one of those conceivable and highly improbable combinations of synchronised magnets, mirrors, and sensitive selenium cells that are so easy to imagine and so difficult to get to work. There have been for some time vague reports of the apparatus, but the *New York Herald* has recently published a more or less detailed account of the arrangement with diagrams. The *modus operandi* is as follows:—By means of two pairs of oscillating synchronised mirrors, small corresponding parts of the picture to be sent, and of the receiving screen, are submitted simultaneously to operation, and the parts operated on succeed each other so rapidly, that in an extremely short time every portion of the picture has been dealt with, and the series begins again. The light from that small part of the picture which, at any instant, is being operated on, is used to modify the resistance of a selenium cell, and a current through this, by opening or closing an aperture, regulates the illumination of the small corresponding part of the receiving screen. Thus every part of the receiving screen in rapid succession is illuminated to a degree corresponding to the brightness of the corresponding part of the original picture. Putting such a scheme into practice seems to bristle with difficulties, but it is said that eye-witnesses have testified to the perfect transmission of pictures. It is, perhaps, more difficult to believe that the Paris Exposition of 1900 has guaranteed the inventor 3,000,000 francs for its exhibition.

**Electricity on Steam Railroads.**—Before the American Railway Master Mechanics' Association recently, Mr. Brangs, the electrical engineer of the Delaware & Lackawanna R. R., read a paper on the subject of the application of electricity to steam railroad traction. The New York *Electrical Engineer* remarks that it was an excellent review of the subject, the speaker showing himself to be in favour of main-line use of electricity, and he made the statement that a ton-mile can be operated by the electric system for less than one-half the cost for fuel, and that the total cost of electric power, including all power station expenses, would not exceed three-quarters the cost of coal for the steam locomotives. A Mr. Hibbard, of Minneapolis, in commenting on the paper, said he thought that electricity was still limited to suburban work, but added: "For suburban service I believe it is to the shame of our steam railroads that they have allowed the electric trolley companies to get ahead of us. • • • It is a shame that we have permitted the electric railways to get almost all the passenger traffic." That is a frank admission, to say the least, but the Consolidated Railroad has shown up at Hartford how the steam companies can hold their own if they adopt electrical methods, with all the increased flexibility and better service that such methods imply.

**Electric Trams for Cuba.**—Our American friends believe in taking time by the forelock. In the development of Cuba they will deservedly find some good business. They have no intention of allowing anyone else to be there before them—in electrical schemes, at any rate, for the *Times* New York correspondent says that American speculators have arrived at Santiago for the purpose of organising brewing, ice, and electric tramway, companies in Cuba.

**The City Company and Motive Power.**—It is stated that the City of London Electric Lighting Company is about to introduce a continuous current system of supply for motive power in the City. New mains will have to be laid, but in the course of about three months the power will be ready for use. The supply will first be available in the wharf and shipping area around Thames Street and the printing district around Fleet Street.

**Booth v. Rhea Fibre Treatment Company.**—We congratulate Mr. W. H. Booth, M. American Soc.C.E., on obtaining judgment on both his claim and counterclaim against the Rhea Fibre Company for work done and fees earned in connection with the Rhea Fibre Company's new works at Castleton, Lancashire.

**Sir Frederick Bramwell on Municipal Electrical Work.**—Sir Frederick Bramwell has written the following letter to the *Times*. The date of the letter is July 20th, previous to the Commons discussion on the General Power Distribution Company's Bill, which appears in our "Business Notices" this week:—

In 1882—16 years ago—you did me the honour to insert a letter, having for its title, "Something More than the Electric Lighting Bill," in which I called attention to the onerous conditions which by the Electric Lighting Act of that year it was sought to impose upon all private enterprises for the purposes of supplying electric energy. In this letter I pointed out how peculiarly unreasonable it was that a then new industry should be stifled at its birth by the imposition of provisions in favour of municipalities which had never been applied to its immediate competitors, the gas companies, or even to railways, &c.—provisions which allowed municipalities or other governing bodies of any district where it was proposed to inaugurate an electric lighting company to acquire at the end of 15 years the electric undertaking on the mere value of the materials suitable for the work at the time of purchase. If the municipality did not happen to buy, its chance of purchase was not gone for ever, for at the end of a further five years the option re-arose, and so on from five years to five years. Thus, as I pointed out, "as long as there is no profit or a poor profit, you, the undertakers, may continue to work, but the instant you get anything like an adequate return, then we will come and buy you up at a price which must inevitably be a comparatively small fraction of the capital you have laid out in your undertaking." The Act which was passed varied the Bill in extending the 15 years to 21 years, and the five years' "recurrence of option" to seven years. As was to have been expected under such provisions as these, no private capitalists would risk their money and go to work, and for six years England lagged behind all the other nations in this industry. This had become so obvious, that in 1888 an amending Act was passed extending the 21 years to 42 years. But the vicious principle of municipal trading still prevailed in that Act, and at the end of 42 years the undertaking was to be acquired upon the then value of the mere materials. This year there has been a Joint Committee of the Houses of Lords and Commons on Electric Energy (Generating Stations and Supply), the report of which Committee has just been published. From that report it will be seen that, as regards undertakings supplying energy in bulk at high voltage, to be used, not only for the purposes of electric lighting, but of power, the Committee think the provisions of the Electric Lighting Acts enabling the local authority to purchase, after a term of years, inapplicable as a general rule; that is to say, the Committee realise that the conditions imposed by the Act of 1882, whereby the interests of the municipalities were fostered at the expense of private enterprise, were inconsistent with the free development of this great industry, and they further realise that the modifications of the 1888 Act are not by any means sufficient or satisfactory, and the evidence before the Committee showed that England is still behind other countries in its commercial employment of electric energy. Since the issue of this report of the Joint Select Committee, there has passed through the House of Lords a Bill promoted by certain influential coal and iron masters in the Midlands (Nottinghamshire, &c.), which Bill is entitled a "General Power Distributing Bill"; this has for its object the supply of electrical energy for lighting, power, and every other purpose for which it is applicable over an area of some 2,000 square miles, being the area of a circle of 26 miles radius, with its centre at Warsop, in the colliery district of Nottinghamshire, where the generating station would be placed. This Lords' Committee passed the Bill and its clauses unanimously. There is no purchase clause in the Bill at all. It has now to be considered by the House of Commons. It has been read a first time, and the second reading is likely to take place on Friday, or on some other very early date. The sole opponents are certain municipalities. These are using every effort to obtain the rejection of the Bill on the second reading, or, failing this, they seek that an "instruction" should be given to the committee that would be appointed to consider the Bill. That is to say, they invite the House of Commons to reject a Bill which is the outcome of the principles approved by the Joint Committee, embracing certain of its own members, without hearing (through its committee) any evidence at all; or, failing that, they ask that the judgement of the committee which would hear the evidence shall be fettered by the "instruction" of the House that has not heard the evidence. In short, by every means in their power they hope to render the report of the Joint Committee a dead letter, and to continue to uphold the mischievous system of municipal trading.—Frederick Bramwell.

**Appointments.**—The Aberdeen Gas and Electric Lighting Committee has appointed Mr. J. A. Bell, of the Blackpool Electric Light and Tramway Works, electrical engineer to the Aberdeen Corporation.

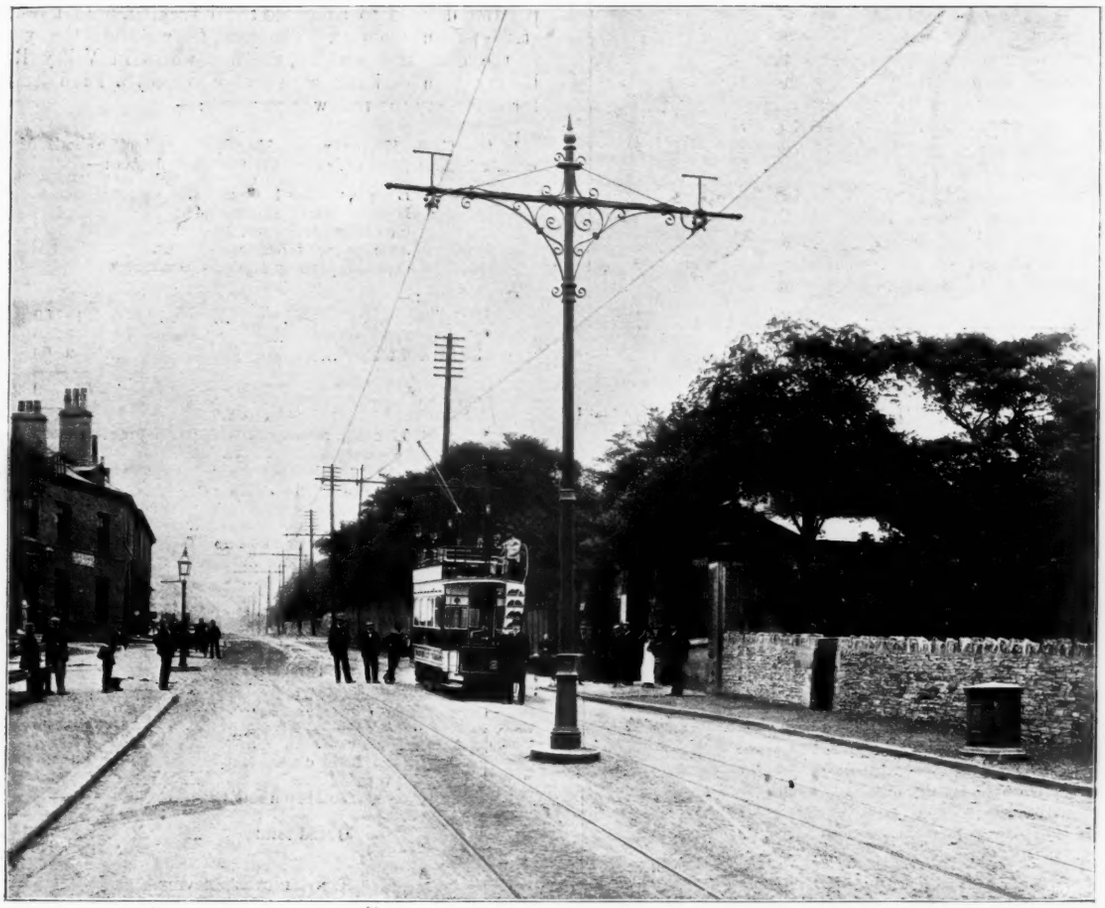
Mr. M. Duncan, second assistant engineer at the Cheltenham Electricity Works, has been appointed chief assistant for the Chester Corporation Electricity Works.

**Presentation.**—On the occasion of his departure from Aberdeen for Poplar, Mr. Blackman was on 23nd inst., presented with a set of ivory dessert knives and forks in a handsome walnut case by his friends at the Aberdeen Corporation electricity works.

(*Continued on page* 168.)

## THE BRADFORD ELECTRIC TRAMWAYS.

It is not more than two or three weeks ago that we chronicled the completion of the Halifax municipal tramways, and we have now to refer to the successful initiation of another corporation tramway, which, curiously enough, is within a few miles of the first named. Bradford has been long distinguished for its municipal enterprise, and the success that attended its venture in a public supply of electricity is too well known to be dwelt upon. Still, the excellent results achieved by the lighting system must have had material influence upon the members of the Corporation under-



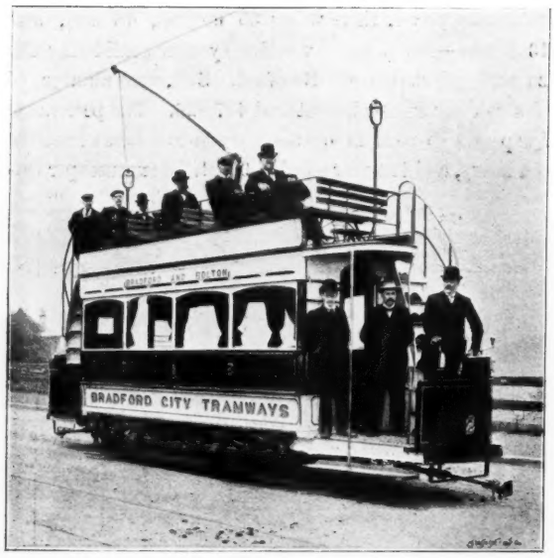
View of Line from Peel Park Gate.

taking the risk of a municipal tramway. Bradford, however, was in a similar position to many other towns in the north of England, and, for the matter of that, in other portions of the country. The routes that were probably best suited for the successful running of a tramway system were being operated by a company under a lease from the Corporation.

Even so far back as 1882, at a time when electric traction was no more than dreamt of, the Corporation of Bradford were alive to the importance of controlling as far as possible local tramways. They did all that was possible for a Corporation to do in those days. They laid tram lines, and then leased them to a company for as short a term of years as possible. As a matter of fact the Bradford Tramways and Omnibus Company was registered in February, 1882, to equip and work the tramways constructed by the Bradford Corporation, under a lease of 21 years. With the available materials the company has done as well as could be expected.

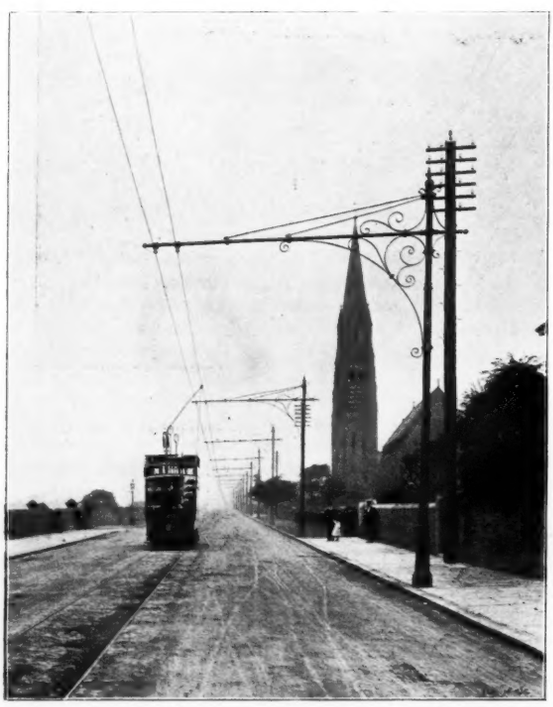
The mileage opened comprises 15 miles of streets and 21 miles of single line. This has been operated by steam and animal power, there being 35 engines, 48 cars, and 143 horses—not a very extensive system, considering the size and population of Bradford. Still, the number of miles run per annum has totalled 447,826. The percentage of expenses to receipts on these steam-cum-horse lines has been heavy, and last year stood at 92·04, the expenses per car-mile being 13d. These expenses, however, have not prevented the company paying a substantial dividend, last year's return to the shareholders being 6 per cent. We have merely mentioned these facts to show that there was considerable scope in Bradford for electrically operated tramways. The system which has just been completed, however, forms no part of the lines operated by the company. By the effluxion of time the tramway lease expires in four years, and there is no reason to doubt that the company will then transfer the whole of its undertaking to the municipality. In the meantime the Corporation has resolved to construct new lines to be operated electrically, and the tramway that we have recently had an opportunity of inspecting forms the first portion of what will eventually be a system of considerable magnitude. The Bradford Corporation have long taken an intelligent interest

in electric tramways, and as far back as 1892 a series of experiments were carried out in Bradford by Mr. Holroyd Smith, and Messrs. Easton & Anderson. The experiments were carried out to demonstrate the efficiency of electrically propelled cars up steep hills, and the portion of the route selected from Forster Square to Manningham Lane was pro-




Car on Line.

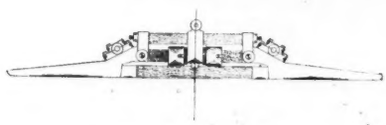
bably the most difficult of the then existing lines, and consisted mainly of a gradient of 1 in 13, and an exceedingly sharp curve. The experiments were successful, but a great outcry was raised against the overhead wires, which were



View of Line Showing Single Arm Poles.

arranged on the cross suspension method; no immediate results accrued from the experiments, though they had an important bearing on the present system. The subject of electric traction in Bradford was revived in a definite form in 1896, when Mr. Alfred Gibbings, the borough electrical engineer, presented a report on the subject to the Corporation.

The chief recommendations of this report were the construction of two lines; one to Great Horton, the total length of route being under three miles, and another to Bolton Road, commencing at Forster Square and terminating at the borough boundary, this route being a little under two miles in length. Although some of the conclusions of the report do not quite apply to the system that has been inaugurated, and the one that will be shortly completed, the following



Section Insulator.

extracts from Mr. Gibbings's report, upon which the Corporation decided to adopt electrical working, are interesting at the present moment. The great feature about the system is the combined working, the new works in Valley Road having been designed with a view to meet a large demand for electricity for tramway purposes:—

In the Great Horton route, Mr. Gibbings took a basis of a 15 minutes' service, and arrived at the following figures:—

Length, 2 miles 1,500 yards.
Number of cars required, 4.
Car-miles per annum, 100,000.
Average speed, 6 miles per hour.
Outward journey occupies 30 minutes.

Capital cost:—

| | |
|---|---|
| Rails, cables, paving, &c. ... ... ... | £15,060 |
| *Four cars at £400 each ... ... ... ... | 1,600 |
| Sheds and offices ... ... ... ... ... | 2,000 |
| | £18 660 |

*Add £400 for each additional car required for emergency traffic.

*Estimated Cost of Running per Car-Mile in Pence.*

| | | | |
|---|---|---|---|
| Working Costs. | Electricity at 1½ unit per car-mile... ... | 2·00d. | |
| | Wages of drivers and conductors ... ... | 2·62d. | |
| | Repairs to stock and plant ... ... ... | 0·48d. | |
| | Lighting and cleaning ... ... ... | 0·19d. | |
| | Repairs to electric feeders ... ... ... | 0·02d. | |
| | Compensation for damage ... ... ... | 0 20d. | |
| | Management ... ... ... ... | 0·59d. | |
| | Stationery ... ... .. ... ... | 0·06d. | |
| | Total working costs ... | | 6·16d. |
| Standing Charges. | Depreciation, cars ... ... ... ... | 0 38d. | |
| | ,, remainder ... ... ... | 1·02d. | |
| | Interest, 3 per cent. ... ... ... | 1·33d. | |
| | Sinking fund, 3 per cent. ... ... ... | 1·33d. | |
| | Rates and taxes ... ... ... ... | 0 52d. | |
| | Total standing charges ... | | 4 58 l. |
| | Grand total ... ... ... | | 10·74d. |

Ten Minutes' Service.

Number of cars required, 6.
Car miles per annum, 150,000.

Capital cost:—

| | |
|---|---|
| Rails, &c. ... ... ... ... ... ... | £15,060 |
| *Six cars at £400 each ... ... ... | 2,400 |
| Sheds and offices ... ... ... ... ... | 2,540 |
| | £20,000 |

*Add £400 for each additional car required for emergency traffic.

| | |
|---|---|
| Total working costs per car-mile ... ... | 5·64d. |
| Total standing charges ,, ... ... | 3·92d. |
| Grand total ... ... ... | 9·56d. |

The foregoing figures are also representative of the cost of running on the Bolton Road route, but owing to the length being shorter, the cost per car-mile will be about 25 per cent. greater than on the Great Horton line.

I have taken these two lines, and estimated the cost of running each as an independent concern. If, however, these lines were worked conjointly, it is clear that many of the items which make up the cost per car-mile would be very considerably reduced, such as charges for management, depreciation, repairs, interest and sinking fund, rates and taxes, &c., probably bringing down the cost to 9d. per car-mile.

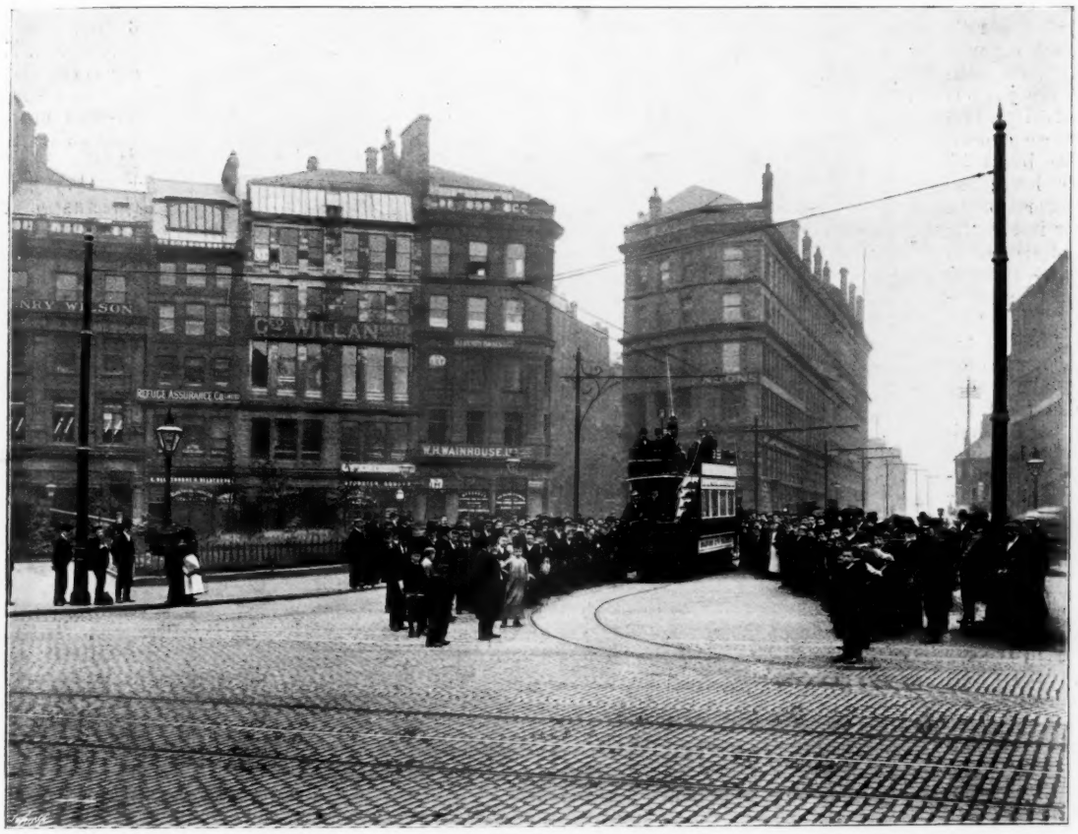
It will also be seen that the additional capital required for a 10-minute service, as compared with a 15-minute service, is small compared with the very material reduction gained in the costs per car-mile, and if the traffic will at all allow, I would recommend a 10-minute service to begin with.

As the traffic increased so the service period could be diminished; and with reference to the probable traffic as compared with present pedestrian traffic, I think a good analogy exists in the results of canvassing for electric light customers compared with the results in

arrangement between the two departments. It will be sufficient if we assume that:—

1. The Electricity Committee retain their independent position, and make a definite charge per unit for all current supplied.
2. That this output is merely considered as a day load.

One further condition, however, is absolutely necessary, viz., that the tramway department, having once made the arrangement for a supply of electricity, it should be considered to be a permanent relationship between the two committees.




Terminus of Line in Forster Square.

applications when once the cable is laid, of which the Committee have recently had several experiences.

The power required for tramcar driving being used in the day time, and the batteries taking up the load at the time of maximum demand upon the electric lighting plant, it follows that the cost of supplying the power will be confined to the cost of generation and the usual allowance for repairs and maintenance. Any charge above this will, of course, be entire profit to the department.

In 1895 the Bradford electricity works' costs for generation, repairs, and maintenance were:—

| | | |
|---|---|---|
| Coals ... ... ... ... ... | ·56d. | per unit. |
| Oil, &c. ... ... ... | ·16d. | „ „ |
| Repairs ... ... ... ... | ·21d. | „ „ |
| Total ... ... | ·93d. | „ „ |

or say one penny per unit, to include wages of one additional man.

If, therefore, a charge were made of 1½d. per unit to the tramway department, we should receive ½d. per unit profit, and this would represent, for an estimated sale of 133,000 units in the year, an income of £277 1s. 8d. Of course this is a small income, but it is gained without any additional expenditure whatever in the electric lighting department, and, moreover, it is representative only of (1) a 15-minutes' service; (2) one length of route; and (3) a definite mileage per annum.

If the service, for instance, were altered to 10 minutes, the income would be increased 50 per cent., and so on for increases of mileage and lengths and number of routes.

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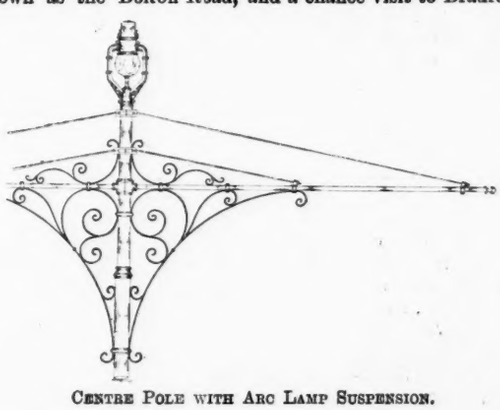
The ultimate effect of such a combined undertaking would, of course, be the possibility of a very great reduction of the price per unit charged for lighting purposes. To the electric lighting concern the acquisition of a substantial day load is of the utmost possible consequence, but further than this there is no need to complicate the

It is clear that Mr. Gibbings has been moderate in estimating the cost of working, and it will be interesting to see how far his figures are verified by actual results.

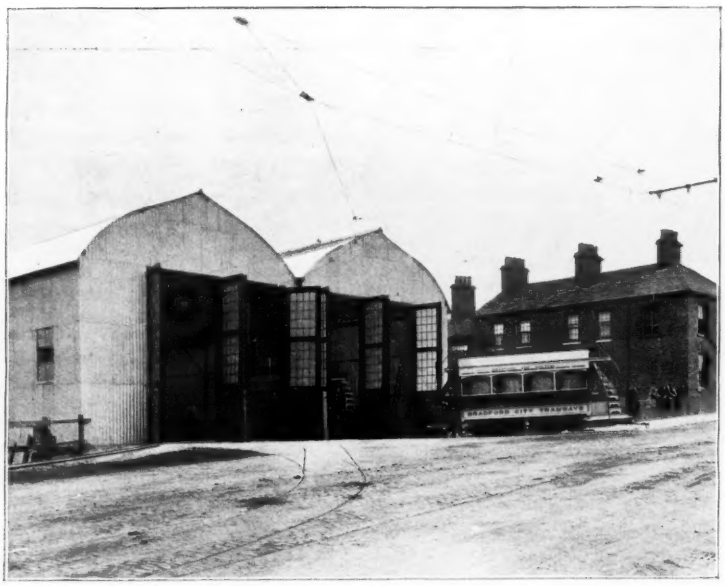
The section of line which has just been completed is that known as the Bolton Road, and a chance visit to Bradford



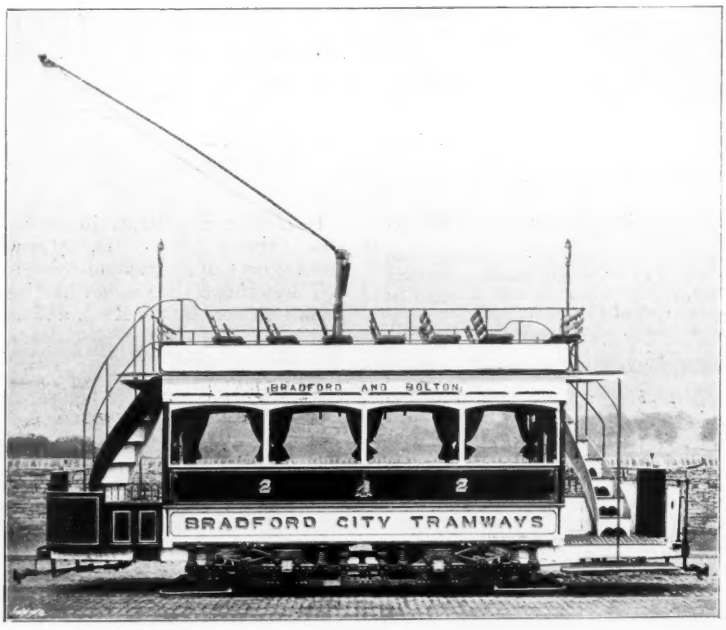
Centre Pole with Arc Lamp Suspension.

last week proved so fortunate for us that we were, through the courtesy of Mr. Gibbings, enabled to travel on the car that made the first complete journey from the tramway depôt to the terminus in the centre of the town. As we have said, the total length of the route is 1 mile 1,501 yards, the

steepest gradient being 1 in 15½, the total rise from one end of the line being 322 feet, which gives an average gradient of 1 in 30½. It is evident that the gradients in Bradford and district are considerable, for the Horton route rises 618 feet, which gives an average gradient of 1 in 24½, the steepest gradient being 1 in 14½. Girder rails weighing 105 lbs. per yard have been used throughout. Between the rails and about 18 inches on each side of the rails the track is paved with granite setts. Each rail joint is bonded with Chicago crown flexible bonds 5¼ inches long; the contact area of the copper inside the web of the rail is about ten times as great as the sectional area of the copper wire forming the bond. In addition there are cross bonds between the rails at intervals of every 120 feet. The poles supporting the trolley wire are of the single and double arm bracket type; our illustrations give typical examples of the poles at the side of the street, and others placed in the centre of the roadway. They are 25 feet above the surface of the ground, and are built up of wrought lap-welded steel in three sections; each pole is provided with cast-iron ornamental finials and collars and an ornamental cast-iron base bearing the city coat of arms. The line work is of the most excellent description, the trolley wire being remarkably well suspended. The wire is of hard drawn copper, ·325 inch diameter, and is divided into the usual half mile sections by means of sectional insulators. A special feature of the sectional insulator, which, in addition to all the line work, poles, feeder pillars, &c., has been supplied by Mr. Robert Blackwell, is its suspension on the brackets. This insulator is shown in one of the illustrations. The feeder switch pillar, from which the adjoining sections of line may be controlled, is at most points placed above ground, and consists of a cast-iron case with water-tight hinged door. It is furnished with six plug switches, test terminals, and lightning arrester, the switches being mounted on marble bases. Two of the switches are for connecting and disconnecting the feeders, the remaining four making connection to the trolley wire. The rolling stock on the system at this moment comprises seven cars, which are elegant specimens of car building. The bodies have been built by the Brush Electrical Engineering Company, and are mounted on the well-known Peckham Cantilever extension trucks; the length of wheel base is 6 feet, and the gauge 4 feet. Each car is furnished with two Westinghouse motors, fixed on the truck on the Westinghouse system of side suspension. The motors are geared to the wheels by single reduction gearing, which is completely enclosed. Series parallel controllers are provided, one at each end of the car, and there are the usual main and emergency switches and lightning arresters. The trolley is of the swivelling arm type, and is the latest form of Dawson trolley supplied by Mr. Blackwell. The arm is mounted on a cast-steel base, and the vertical movement is controlled by two sets of side springs, the arrangement of which will be seen in the drawing. The average running pressure of the trolley is 16 lbs. The trolley head is completely insulated from the trolley pole, the wheel being of the well-known "West-end" type. It ought to be mentioned that the cars are built to carry outside passengers, the full complement of passengers being 51—22 inside and 29 outside. The cars are lighted with 10 incandescent lamps each, arranged in two circuits of five lamps in series supplied, with current direct from the trolley wire.



View of Car Sheds.

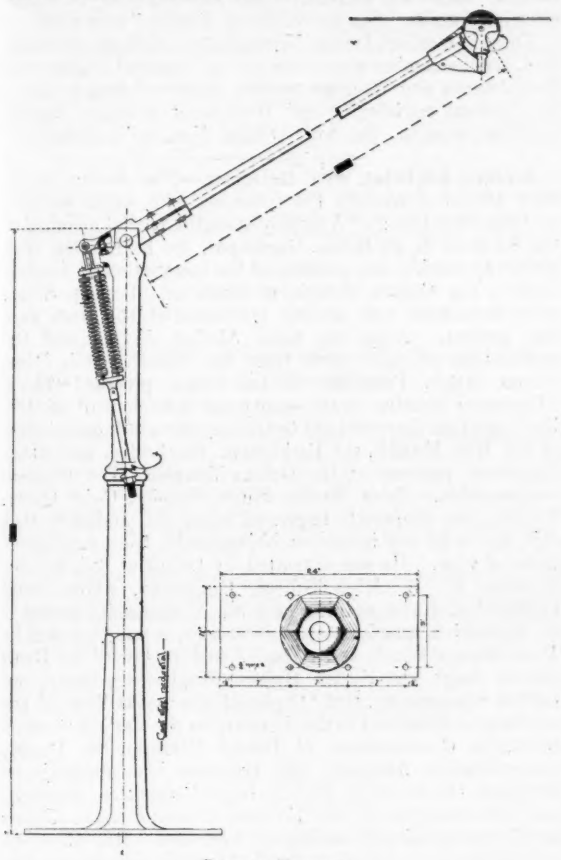



View of Car.

The car shed is erected near the end of the line, and will accommodate a good many more cars than it is intended to use for some time.

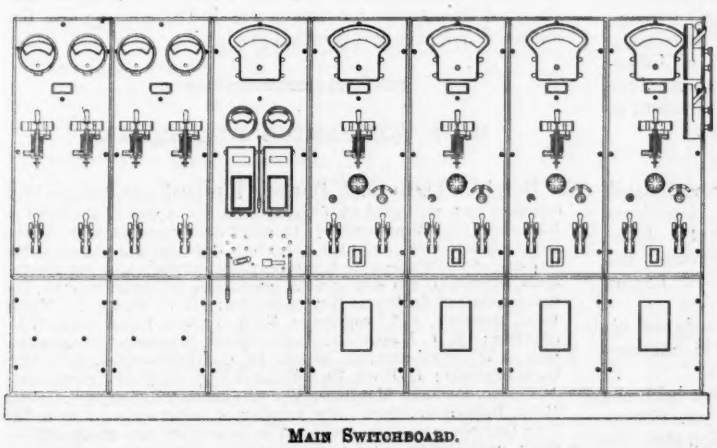
It is hardly necessary to say that the current for the line is supplied from the lighting station in Valley Road, a description of which appeared in the Electrical Review some time ago. It will be remembered that the principal features of the station were the multipolar dynamos; for some time, at

least, the supply to the tramway system will be obtained from one of these machines, but to meet the demand that will



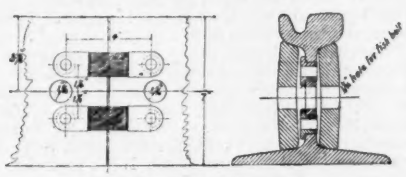
Dawson Trolley.

arise when the Great Horton section is complete, other machines are being erected. The only feature in the station that suggests a tramway is the special switchboard which



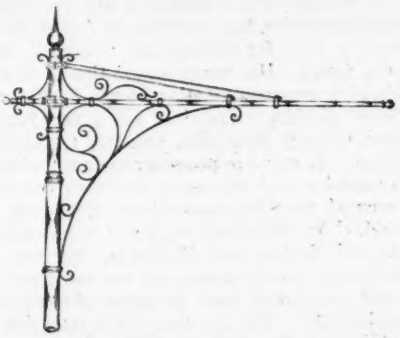
Main Switchboard.

has been set up. The base of this is of black marble, and has a most handsome appearance. It stands some



Double Crown Bonding.

4 feet away from the side wall, thus giving ample room for examination. There are feeder panels, generator panels, and the usual panel devoted to carrying out tests in accordance with the Board of Trade rules. Each panel is provided with the usual measuring instruments and an automatic circuit breaker. This latter is of the Cutter type, and is identical with the one described in the account of the Halifax tramways on June 24th, 1898. We understand that



Side Arm Bracket.

the switchboard has been supplied to the Corporation by Mr. R. Blackwell, who has been also a sub-contractor for the other work to the Westinghouse Electric Company, Limited, who are the principal contractors for the line.

We are indebted to Mr. Gibbings, the city electrical engineer, for assistance in compiling the foregoing details.

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**Mr. Ritchie on Light Railways.**—On 21st inst. Mr. Ritchie, President of the Board of Trade, performed the ceremony of cutting the first sod of the light railway which is to be laid from Basingstoke to Alton (12 miles) by the London and South-western Railway. He took the opportunity, when proposing success to the line, of making some interesting remarks upon light railway matters. The line, which we believe is to be worked by steam, will be completed in 12 months, and is the first of its kind to be constructed under the Light Railways Act. Mr. Ritchie was at one time afraid that the great railway companies would look upon light railways with suspicion, but he had found that his fears were groundless. Applications under the Act had been very numerous, and are still increasing. So far, as many as 121 applications for orders had been laid before the Light Railway Commissioners, such applications representing 1,305 miles and £7,500,000 capital outlay. It is interesting to note that about 32 applications came from existing railway companies, and 14 others referred to lines to be worked by railway companies. The cost of making an ordinary railway from Basingstoke to Alton had been estimated at £36,000 a mile, but the light railway which is to be constructed will cost about £5,360 per mile only, these figures showing the great advantage gained by means of the Light Railways Act. Another point was that the promoters, instead of spending about £1,000 in applying for Parliamentary powers, had only to spend £150 by applying under the new Act.

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**Electric Traction at Terminal Stations.**—An American exchange, which has at various times commented upon the advantages of electric traction for handling the trains of steam roads at the terminals in large cities, and pointed out that this is probably the most promising field for the application of electricity on such roads, says:—"The plans of the Orleans Railroad, of France, for a line connecting its present Paris terminal with a station in a more central part of the city, contemplate its operation by electricity; and this is the most recent instance of the appreciation of this motive power for such purposes. This undertaking involves an expenditure of $8,000,000."

## NOTES.

(*Continued from page* 162.)

**Water-Power Utilisation for Simla.**—Mr. A. Younghusband, the engineer who is concerned with the Simla Waterworks extension scheme, has, according to *Indian Engineering*, put forward a plan for utilising the "power" running to waste in the Sutlej. His rough calculation is that it would be possible, at a reasonable outlay, to get 8,000 horse-power at Suni below Naldira. The river has a very rapid current in its course through these hills, and thus turbines could be easily worked. It would be necessary to dam the stream, and to have a tunnel or rock cutting to give the required "drop." Having secured the 8,000 horse-power all the rest would be easy enough. An unlimited supply of water could be sent into Simla *viâ* Naldira and Mashorba, dynamos could be driven to furnish electric energy and for the lighting of the station, and we should hear no more of catchment areas, fouling springs, &c. The question of the extension of Simla, too, would be solved. At present Mashobra cannot expand, because the spur on which it stands is almost waterless for several months in the year; while Naldira, with its lovely sites for country houses, is too far away. But the Sutlej project would sweep away these difficulties; an electric tramway would link Simla with its new suburbs, and Naldira would be within an hour of Jakho.

**Enclosed Arc Lamps with Incandescent Lamp Resistance.**—Mr. J. W. Mabbs has given, says *Industries and Iron*, the results of some experiments on the substitution of an incandescent lamp in place of wire resistance. An enclosed arc lamp works better with a lamp resistance, and there is the further advantage that the incandescent lamp can be utilised for lighting. He used six lamps in multiple series, each consuming one ampere. These incandescent lamps are about 4 watts per C.P. When one lamp breaks the other five will carry the current until the broken lamp is replaced. Eight to ten arc lamps have been thus fitted, the incandescent lamps being placed from 50 feet to 60 feet distant.

**Obituary.**—The *Standard and Diggers' News* records the death of Mr. R. O. G. Drummond, who was formerly borough electrician of Kimberley, and has recently acted as consulting electrical engineer to Messrs. Reunert & Lenz, at Johannesburg. Mr. Drummond, whose death occurred on June 23rd, was only a short time ago appointed vice-president of the South African Society of Electrical Engineers.

**Personal.**—In the *Journal Officiel* of France, dated 24th inst., we notice that M. Emile Baudot, Inspecteur-Ingénieur des Postes et des Télégraphes and inventor of the well-known multiplex telegraph printing instrument, has been promoted to the grade of Officier de la Légion d'Honneur.

Mr. H. M. Salmony informs us that he has resigned his position as managing director of the firm of H. M. Salmony and Co., Limited.

Mr. H. E. Mitchell, who has for many years past held the position of chief assistant and secretary to Prof. George Forbes, F.R.S., has recently been offered and accepted the post of manager to Mr. Francis Hastings Medhurst, B.Sc., M.Inst.E.E.

**Institution of Mechanical Engineers.**—The summer meeting of this Institution was opened on Tuesday at the Midland Railway Institute, Derby, Mr. S. W. Johnson presiding. A paper was read by Mr. E. Ristori (London) on the "Manufacture of Aluminium," with a description of the rolling mills and foundry at Milton, Staffordshire. A lengthy discussion followed, in which Messrs. B. Donkin, Thornycroft, and Mills, and Sir W. H. White took part.

**X Rays.**—The Duke of Newcastle is presenting a complete and valuable X ray outfit to the North-Eastern Hospital for Children at Hackney.

**Appointments Vacant.**—The Llandudno District Council want an assistant electrical engineer for their electricity works. See our "Official Notices" this week.

There is required for the Northampton Institute, Clerkenwell, for the coming winter session, an electrical engineering draughtsman and designer to take charge of design classes in electrical engineering and instrument making. Salary £120 per annum. See our "Official Notices" this week.

**Electric Lighting and Religion.**—The *Madras Standard* published recently the following note, which we give without alteration:—"A largely-attended special meeting of the Sri Guru Singh Sabha, Gurdaspur, was held on the 20th ultimo to consider the question of the installation of electric light in the Golden Temple of Amritsar. Besides Sikhs, other respectable and leading gentlemen of the town were also present. After the usual *Shabad Kirtan* and the explanation of some verses from the Granth Sahib, Bawa Charat Singh, President of the Sabha, proposed that—'Extremely pleasing is the beauty and splendour of electric light, and that there will not be the least harm if it be installed at the Hur Mundir, the Parkarmas, the bridge, and other important portions of the Golden Temple.' The proposal was seconded. Bawa Sunder Singh, Pleader, Chief Court, Punjab, who eloquently impressed upon the audience that *bijli* was in no way impure or objectionable from a religious point of view. He was supported by Lala Mul Raj, Science Teacher, M. B. High School, Gurdaspur, whose lucid explanation of the meaning and use of electricity caused it to be carried unanimously. After this, it was proposed by Bawa Mangal Singh, and seconded and supported by Bawa Mahan Singh and Sirdar Hukam Singh respectively, and carried unanimously, that 'Copies of the proceedings of the meeting be submitted to the Secretary to the Punjab Government, the Commissioner of Lahore Division, the Deputy Commissioner, Amritsar, His Highness the Maharaja of Faridkot, the secretary, Electric Light Committee, Amritsar, and also the editors of the *Tribune*, *Khalsa Gazette*, *Khalsa Akhbar*, and *Khalsa Bahadur*,' and that 'His Highness the Maharaja, Faridkot, be thanked for his valuable services to the Durbar Sahib as well as for his liberal contribution to the Electric Light Fund.' The *Tribune* says that the speeches of Mahant Ram Nath, Jagirdar and Gaddi Nashim of Gurdaspur, Mahant Shankar Nath, and Dr. Kalu Ram, before the meeting dispersed, went a long was to prove that the opposition to the movement was due to nothing else but mutual differences and personal grudge."

## NEW COMPANIES REGISTERED.

**Bright's Light and Power, Limited** (58,290).—This company was registered on July 21st, with a capital of £200,000 in £1 shares (100,000 preference), to adopt an agreement with Charles Bright, and to carry on in the Argentine Republic and elsewhere the business of undertakers for the supply of electricity and gas, electricians, electrical, gas and general engineers, millwrights, &c. The first subscribers (with one share each) are:—R. G. Fudge, 71, Manor Road, Brockley, S.E., secretary; V. A. Brown, Hotel Cecil, W.C., engineer; F. J. Harris, 32, James Street Mansions, Buckingham Gate, S.W., gentleman; C. Bright, 14, Copthall Avenue, E.C., electrical engineer; J. Oliver, 74, Goldhurst Terrace, N.W., gentleman; J. Thorne, Portman Mansions, W., gentleman; T. Large, 8, Coburg Road, Teddington, clerk. The number of directors is not to be less than four nor more than seven. The subscribers are to appoint the first; qualification, £200; remuneration, £200 each per annum, and £300 for the chairman.

**Hampstead Electric Supply Company, Limited** (58,293).—This company was registered on July 21st, with a capital of £200,000 in £5 shares (20,000 £5 per cent. cumulative preference), to acquire the business of the London and Hampstead Battery Company, Limited, and the business carried on at Rosemont Road, Hampstead, and elsewhere by Joseph Taylor, to adopt an agreement with Wm. S. Rainbow, and to carry on the business of electricians, electrical and mechanical engineers, and suppliers of electricity. The subscribers (with one share each) are:—Miss E. A. Faithfull, 1, Cologne Road, New Wandsworth; C. A. Goffin, 36, Sarsfeld Road, Balham, secretary; E. Lovelock, 64, Victoria Street, S.W. caretaker; A. W. Armstrong, 85, Broadhurst Road, N.W., engineer; R. J. R. Goffin, St. Margaret's Lodge, Palace Street, S.W., gentleman; W. L. Butler, 47, Norroy Road, Putney, S.W., clerk; H. Marston, jun., 9, St. Mary's Grove Gunnersbury, W., clerk. The number of directors is not to be less than three nor more than seven; the subscribers are to appoint the first; qualification, £250; remuneration, £200 each per annum, and £250 for the chairman.

**New British Incandescent Electric Lamp Company, Limited** (58,316).—This company was registered on July 22nd, with a capital of £30,000 in £1 shares, to adopt an agreement with the British Incandescent Electric Lamp Company, Limited, and to carry on the business of incandescent and other electric lamp manufacturers, electrical engineers and contractors, electricians, &c. The first subscribers (with one share each) are:—I. Andrews, 21, Hamlet Road, Southend-on-Sea, engineer; Miss M. A. King, 36, Spey Street, Poplar, E.; E. C. White, 44, Kenwyn Road, Clapham, S.W., electrical engineer; Miss E. Nicholls, 7, King's College Road, N.W.; Miss F. A. Simpson, Silverdale, Tarbert Road, East Dulwich, S.E.; H. P. Stunt, 12, Akerman Road, Brixton, S.W., clerk; C. R. Leighton, J.P., Blackbrook, Bickley. The number of directors is not to be less than three nor more than seven; the subscribers are to nominate the first. Qualification, 1 share; remuneration, 52 guineas each per annum.

## OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

**Hooper's Telegraph and India Rubber Works, Limited** (40,947).—This company's annual return was filed on June 25th. The capital is £50,000 in £10 shares (1,000 preference). 1,000 preference and 1,050 ordinary have been taken up, and the former considered as paid. £10 per share has been called on 550 ordinary, and £6 per share on 500 ordinary, and £8,500 has been received.

**Larne Electric Light Works, Limited** (46,962).—This company's return was filed on July 6th. The capital of £4,000 in £1 shares (500 preference). 255 preference and 3,500 ordinary have been taken up, and the former have been paid for in full, while the latter are considered as paid.

## CITY NOTES.

### Brazilian Submarine Telegraph Company, Limited.

An extraordinary general meeting of the above company was held on Wednesday last at Winchester House, Old Broad Street, for the purpose of considering the proposed working agreement between this company and the Western and Brazilian Telegraph Company. Mr. J. Denison Pender occupied the chair, and said that the following paragraph in the report contained in a few words the chief reasons which had led the boards of the two companies, and of the Platino Company, to conclude the arrangements referred to. The paragraph to which he referred was the following:—

"These two companies having been formed under the same auspices, and being bound together by joint purse agreements, it has long appeared to the board that a closer union would greatly promote their common interests, and tend to increased prosperity and increased stability if satisfactory terms could be arranged."

A few weeks ago, when he had the pleasure of addressing the shareholders at the ordinary meeting he held out hopes—in fact, he went so far as to say he was sure—that they would shortly be called together to consider an agreement for a much closer working with the Western Brazilian Company, and the meeting that day was in fulfilment of that promise. Never before had they met to consider—and, he hoped, to pass—a more important agreement than the one he was about to submit to them. It was the result of many months of hard and constant work, but before he requested Mr. Davies, the solicitor, to read the heads of agreement, he would very briefly describe the geographical positions of the companies with which they were about to have more intimate relations. Early in 1873, the Brazilian Company and the Western Company were formed to provide telegraphic communication with South America—the former to lay ocean cables from Lisbon to Pernambuco, and the latter a coast cable from the northern to the southern provinces. Communication with Uruguay and Argentina was subsequently provided by other companies—the Platino Company, and the Montevidean Brazilian Telegraph Company. There were, however, five separate companies concerned in laying and working the lines between Europe and Argentina. That was chiefly due to the fact that it was not then quite so easy to get money for laying telegraphic cables as it was to-day, and undoubtedly if such a work was done now it would be undertaken by one company, and not divided up among five. As was natural and prudent under the circumstances, arrangements for mutual benefit and support were made by the companies in the way of pooling the receipts. The Western Company and the Brazilian Company from the first pooled their joint receipts, but neither had a voice in the management or expenditure of the other. The Western also had a joint purse with the Platino Company and the Montevidean Company, by which they practically rented, and in reality controlled those two companies, and thus avoided separate management. Subsequently, by an exchange of shares, the Montevidean Company was acquired and merged into the Western Company, and by a similar process nearly all the shares of the Platino Company had been acquired by the Western Company. Therefore, it would be seen that during the course of years that the Southern Companies had been in existence, they had gradually amalgamated and joined together in one way or another, and now they proposed to carry that a step further, and bring the Brazilian and the Western Companies closer together. The growth of the traffic had called for the duplication of the Brazilian Company's entire system and of the Western Company's cables between Pernambuco and Monte Video, and that work was carried out some years ago. In 1894 the Western Company and the Brazilian Company, with the West Coast of America Company, combined for the erection of land lines from Buenos Ayres to Valparaiso, where these lines joined the coast cables of the latter company, and thus their route had the advantage of the West Coast Company's collecting and delivery ground in Chili and Peru. Competition had arisen at various points. A cable from New York passed through the West Indies to the north of Brazil. That was a French cable, and was known as the French route, and was in connection with a cable across from France to the United States, and to deal with that competition properly it was necessary that the British companies should have one policy and not divergent interests. The only efficient way of obtaining that was by widening the scope of the existing joint purse—to have, in fact, a working agreement. As a partnership agreement it was true that the present joint purse agreement had worked fairly well so far as it went, but it carried with it no obligations as to expenditure, or the acceptance by all concerned of any joint policy. Frequently the interests of the different shareholders might clash and law suits had arisen, which, of course, was a very undesirable thing. Under the proposed agreement all such difficulties would disappear, and the joint working under one board and under one management could, in their opinion, only lead to results beneficial to the united bodies of shareholders. Consideration would not, in the future, have to be given to the special interests of any one company, but to the interests of the whole; and having regard to the traffics which they carried, the interests of the whole must be the interests of the individual companies. The arrangement would also naturally lead to an improvement in the service, which would be advantageous to the South American Governments, to the producers on the other side, and to the merchants and traders in all parts of the world who dealt with South America. For some years it had been felt that an arrangement would be beneficial, and it was, therefore, with great pleasure and a certain amount of pride that he brought the present agreement before them. He did not mean to say that they had got all they asked for, but they would agree with him that such an important understanding could not have been arrived at without a good deal of give and take on both sides. The Western Company were holding their meeting to put the agreement before their shareholders, and to get the required sanction to carry it through. Contrary to their general practice, they of the Brazilian Company had sent out proxies, as they felt that the matter was one upon which the smallest as well as the largest shareholder should have an opportunity of expressing an opinion. They had received a very large number of replies, and, with practically one exception, they were all favourable to the policy of the board, and the gentleman who had dissented on the present occasion, was a gentleman who always dissented to the accounts every half-year. He still, however, went on holding his shares, which, if he cared, he could sell at a good profit, so he could not be so very dissatisfied. Regarding the basis of valuation which had been agreed upon, it was quite fair to take the market value at the start, but directly it was known that the two companies were in negotiation with a view to a working agreement, the Stock Exchange value of the shares began to change. He thought, therefore, the shareholders would agree with the board that it was not proper to rely upon the market value any longer. They considered the matter in this way: the shareholders had for a considerable number of years had a fair dividend—7 per cent.—and they had had their capital strengthened by putting a considerable amount to the reserve—some gentlemen thought too much; but that was a point upon which the board felt very strongly. Looking to the past, and as far as possible looking to the future, they had considered whether by the agreement they would be able to give the shareholders the same dividend and continue to strengthen the capital by adding to the reserve. They found that they could do that, and therefore they strongly recommended them to accept the terms put forward. He did not mean to say for one minute that they had got all they asked for—they had not, and he went further and said that they had treated the Western shareholders liberally. But look at the present position! They had got a cable running from Lisbon to Buenos Ayres, carrying the same traffic, divided into two managements and two companies. In the future there would only be one board, and that would mean the saving of much time when difficult questions came before them. He believed that the deferred shareholders in the Western Company were rather dissatisfied with the arrangement, but look at the value of their shares before the negotiations were entered upon! The value then was about £2, but directly it was known that the two boards were in negotiation, there was a speculative value put upon them, and they rose to £5. Then when the agreement came out, and they found they were to get £4 8s. 11d., the shares naturally fell to their actual known value. He did not see that they had any reason to be dissatisfied, but he could safely say that if the agreement was thrown out—and if it was, it would only be by the action of those deferred shareholders—their shares would tumble back to their old price. In conclusion, the chairman moved the resolutions, which appeared in the Electrical Review last week.

Mr. F. Youle seconded the resolutions.

Dr. Ellery-Trewhella said he felt sure from their past knowledge of the board the shareholders would maintain their confidence in them, and unanimously approve of the proposal which they had brought before them.

Replying to a question, the Chairman said they had taken power to raise more money than they wanted, but at present they only contemplated raising sufficient to carry through the agreement—£811,000.

The resolutions were then unanimously agreed to.

The Chairman announced that a confirmatory meeting would be held on August 11th.

## London Platino-Brazilian Telegraph Company.

An extraordinary general meeting of the above company was held on Wednesday last at Bloomfield House, London Wall, for the purpose of sanctioning an agreement with the Western and Brazilian Telegraph Company and the Brazilian Submarine Telegraph Company. Mr. W. S. Andrews, who presided, formally proposed the adoption of lengthy resolutions similar in effect to those submitted to the Brazilian Submarine and Western Brazilian Company, which was unanimously agreed to.

## The Western and Brazilian Telegraph Company, Limited.

Mr. W. S. Andrews presided at an extraordinary general meeting of this company, held at Winchester House on Wednesday, "for the purpose (*a*) of considering and, if thought fit, sanctioning an agreement, dated July 14th, 1898, and made between the Western and Brazilian Telegraph Company, Limited, of the first part; the London Platino-Brazilian Telegraph Company, Limited, of the second part; and the Brazilian Submarine Telegraph Company, Limited, of the third part; and (*b*) of considering and, if thought fit, passing the resolution which we printed last week:—

The Chairman said: Gentlemen, I do not propose to say much before the agreement is read, but I would observe that the agreement is the outcome of very many months of continuous labour and consideration; and that I think it is a good measure in the interests of all the shareholders, and will place them in a position where there will be an absence of those violent fluctuations which we have had so frequently to lament of late years in the conduct and management of our business. The financial unity of the concerns will be very great, and we believe that they will work very largely to the increased advantage of the proprietary. He asked the solicitor to read the proposed agreement.

The Solicitor read at length an agreement, dated July 14th, 1898, between the Western and Brazilian Company, the Platino Company, and the Brazilian Submarine Company, which, he stated, was to be supplemented to previous agreements. He also read an agreement with regard to the exchange of shares between the companies, which appeared in table form in the Electrical Review last week.

The Chairman: Gentlemen, you have heard read these not over simple documents—lawyers do manage somehow or other, especially in a case like ours, where there are complications, to say so very many words which we ourselves should not think of providing for. I do not think they have gone too far, but rather that they have been very careful and prudent over this business, and have acted with very great sagacity. Before going further I may say that we have received very large support from the shareholders, although they have not had the benefit of hearing these agreements or of hearing the explanations which you will have; and they have forwarded between, I think, 46,000 and 50,000 votes—their proxies—to denote their approval of the arrangement which has been come to. In fact, I have received from only a very few shareholders any intimation of dissatisfaction, and those are from gentlemen who think the deferred are not getting quite so much as they should. I think we shall show that the deferred are getting proportionately, in the shape of dividend, more than and considerably more than any other shareholders. You will have observed one fact in all these documents, and it is that we do not to-day speak of amalgamation. This is not an amalgamation at all between the companies, nor does it partake of the nature of an amalgamation. It is simply an arrangement for closer working between the companies, each company continuing its separate existence with its separate accounts and revenues, and with its separate responsibilities and obligations. With respect to the idea that has prevailed in the minds of some shareholders, it will be seen that, as the companies are continuing companies, the fact that the deferred shareholders would come in in the case of a winding up for a share of capital equally with the deferred, has no application whatever in the present case, because this proposed arrangement continues the working activity of the of the companies in all respects. Every effort was made by the directors—and they have no personal predelictions or desires in any of these matters—to procure such an offer to be made by the Brazilian Submarine Company as would be satisfactory to the shareholders, and I think when I call your attention to this remarkable fact that during the last five years the dividends received by the deferred shareholders amount per annum to only 9d. per share, or a total of 10s. per cent., and that under the proposed arrangement they might get 3s. 10d., two-thirds per share on each £7 10s.—the previous calculation was in respect of £7 10s.—they will be receiving £2 11s. 10d. per cent. per annum. Now if you compare that with the 10s. per cent. received for the five years, I think you will agree that the deferred shareholders have very little to complain of; and as I have said they are proportionately in a better position than all the other classes of shareholders. Whereas, by remaining separate we all know that the deferred shares have to stand the racket of the enterprise. The preferred who get the very small interest of £3 5s. 8d., are, on the other hand, in a protected and safe position. The deferred has to suffer all the losses, too, which may be very great, and, as you know, have received nothing for a very considerable period. Besides this, it must not be forgotten that what the Brazilian Submarine will offer the shareholders is practically an option, which they may accept or they may reject. If they accept the offer they would become shareholders of the Brazilian Submarine Company. If, on the other hand, they decline it, those declining it simply remain as at present, shareholders in the Western and Brazilian Telegraph Company. They continue, under the existing agreements, the revenues and expenses which will still be kept separately and independently as now. It is quite true that the Western and Brazilian, and the Platino revenues, are improving in a very satisfactory way. But then the revenues of the Brazilian Submarine are improving, also, in a very satisfactory way, and we cannot improve without they improve, and the character of the position is seen by this—that they improve more than we do; consequently, any gentlemen who exchange out of the Western and Brazilian Telegraph Company will not be giving up an improvement which we are so glad to see at present, but they will be actually increasing that improvement, and really going one better, by getting that which they would otherwise not receive. At times there have been frictions between the companies, owing to separate and contrary points of view. Our present object is by identifying interests more nearly to harmonise these views between the companies, so that there may be no conflicting interests. We believe that the result of the joint boards and the united working of these companies will be to produce a satisfactory economy which will, of course, go to the benefit of proprietary. What has worked a good deal with us is this—that we believe that by uniting our action and by working together we may largely improve the conduct of the lines, and that we may be enabled to give increased facilities which will largely encourage the development of traffic. Of course, by these means we should then obtain an improved service alike in the interest of the Governments and a great improvement of mercantile and general interests of Brazil and of other parts of South America as well as of this country and Europe and North America. Those shareholders who exchanged their shares would obtain increased financial strength with less fluctuation, but more secure. The change would be for the benefit of the ordinary as well as the preferred and deferred, and although the preferred got a very small advantage, it will be remembered they would be protected against all worries and troubles and of dividends deferred. The great thing is, that by this arrangement we improve our service, and we are, as we believe, endeavouring to give more satisfaction to the Governments, and the governmental interests will be better served by the stronger association of capital such as this arrangement will present than they are even served at present, although we have always done our best to meet their views. He then proposed a resolution according to the notice convening the meeting.

Mr. Goodsall seconded the resolution.

Major Cotton thought the shareholders were very much indebted to the board for the scheme now laid before them. The idea of the scheme was a very good one, and he thought it should be received by the meeting with unanimous support. But he was a deferred shareholder, and, as such, was not altogether satisfied with the allocation of the shares they would receive from the Brazilian Submarine. But that was a very small matter, for the scheme was a splendid one for the ordinary and preferred shareholders; and even if nothing could be done for the deferred shareholders by its being modified in any way, he suggested that it still would be very desirable for them. They held rather more than one-sixth of the capital, and he thought they were entitled to some representation, and that their views should be listened to. He found upon inquiry that the directors were not interested in the deferred shares. The preferred shareholders were entitled to a cumulative 5 per cent. dividend, whereas the deferred shareholders only received 9d. per share. However, the matter was one which might well be left to the directors. Another reason why the deferred shareholders ought to be rather liberally treated, he thought, might be found in the increased receipts. Their receipts had increased this year something like 25 per cent. The last half-year the increase was £73,500 against £59,350. They had actually had an increase in the past half-year to the satisfactory extent of £14,164, and with the addition of the increase for the current half-year so far, the total increase was £14,731, which with a £4,000 increase from the Platino, gave a total increase up to date of £18,731. That state of affairs made him very hopeful for the future as a deferred holder. He suggested that they ought to get a little more; but still, the scheme was so good that if they could not get more deferred shareholders would be foolish not to fall in with and take what was offered. He suggested that a fair ratio would be to give for each 18 Western preferred shares nine Submarine ordinary shares, and for each 18 deferred shares six Submarine ordinary shares.

The Chairman, under the advice of the solicitor, remarked that the scheme could not be modified.

Major Cotton said he looked upon the agreement as constituting practically an "amalgamation."

The Chairman, interposing, remarked that he was particularly anxious in his speech to impress upon the shareholders that it was not an amalgamation, but that the proposals embodied a closer working arrangement.

The Chairman, in reply to some comments of Mr. Ellis, said the percentages remained as they were under the existing agreements. As to expenses, the same remark applied. The shareholders in the company could exchange a part instead of the whole of their shares if they chose to do so. The proxy question had been much discussed, and he quite admitted that it was an unusual clause. The agreement, however, was an unusual one. The object of the proxy clause was to neutralise the absence of any particular director at a critical period. He repeated that, in his opinion, the deferred shareholders got the greatest advantage of all the parties.

The resolutions were carried, and a vote of thanks was given to the chairman.

## Consolidated Telephone Construction and Manufacturing Company.

THE meeting of this company was held on Thursday last week, at Winchester House, to consider the directors' report for the year ending March 31st. The report stated that "the total income for the year on revenue account amounts to £2,574 14s. 6d., including £800 paid by the Edison Gower-Bell Telephone Company of Europe, Limited, on account of dividends already declared. Deducting expenses, amounting to £1,870 3s. 2d., and including the amount brought forward from last year, a balance is left of £1,713 9s. 11d., out of which the directors propose to pay a dividend of £1 10s. per cent. (less income-tax), carrying forward a balance of £83 6s. 8d." It adds:—"Your directors much regret to have to state that the total sales 'turn over' for the year was very considerably below that of previous years. The hoped-for business in bicycle screws and accessories unfortunately has not been realised, owing to the general cessation of that trade. The factory has, however, been more fully occupied lately, a state of affairs which it is hoped will continue. Prices are still severely reduced by competitors, both English and foreign, many tenders being taken by them at what appear to be absolutely profitless figures. The rentals from private telephone lines continue to increase, and no doubt will do so. The directors would be glad if the shareholders would give facilities for assisting the executive in furthering the company's interests. The shareholders are no doubt aware of the desire of many important cities, such as Glasgow, Manchester, &c., to have their own telephone exchanges, and your directors are hopeful that licenses will eventually be granted by the Postmaster-General, whereby a large demand for telephones and all materials connected therewith may reasonably be expected by this company, as being the largest and oldest manufacturing company in the United Kingdom for such specialities. As a case in point, a license for an exchange has recently been granted by the Postmaster-General to the States of Guernsey, and the telephones required have been supplied by this company. Friendly relations continue with the various Government departments, both at home and in the Colonies, and it is also satisfactory that nearly all the railway companies of the United Kingdom place their orders with us for telephones and accessories connected therewith. Contracts for 12 months' supply have in some cases been entered into. Concerning the lawsuit in Belgium carried on by the Edison Gower-Bell Telephone Company, of Europe, another of the infringing companies has come to terms. The Anglo-Portuguese Telephone Company's business remains practically stationary since the last report. In accordance with the articles of association Mr. Arthur Henry Baker retires by rotation, and being eligible, offers himself for re-election. The auditor, Mr. J. G. Griffiths, F.C.A. (Messrs. Deloitte, Dever, Griffiths and Co.), also retires, and offers himself for re-election. Having regard to the present position of the company's business, the directors desire to avail themselves of this meeting to ascertain as far as possible the views of the shareholders as to the future, and they therefore trust that all shareholders who can do so will make an effort to attend."

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Mr. C. L. FITZGERALD presided, and in his speech to the shareholders, said that no one regretted the very poor results of the manufacturing during the year more than the board. Two years ago the factory was moved to Coventry, and that year they had a very poor result, but they then hoped to make more money in Coventry by having lower wages and expenses. Last year they made a profit of about £2,000, and at the commencement of the present year they were fairly full of work, but from that period up to within a very short time ago, they were practically without orders. At times it almost appeared that they would have to close the factory to wait for orders. They did not absolutely have to do that, but they had made a very small profit indeed from the manufacturing. The rentals from their private lines kept on increasing, and would do so. Going through the figures in the balance-sheet, the chairman showed that the total income for the year was £2,574, and after deducting ordinary expenses there was a balance of £1,713 odd from which it was proposed to pay a dividend of £1 10s., this left a very small sum to carry forward. Apart from the manufacturing business things were fairly satisfactory. Income from investments amounted to £2,450. The stock had increased, as when there were no orders the men were employed making stock. The last paragraph in the report was the most important the meeting had to consider. The chairman said that the board proposed that the report and accounts should be adopted, and a meeting held in a month's time to discuss the question of the future at length.

The motion was seconded by Sir ALEX. ARMSTRONG, and carried unanimously.

There was a brief discussion regarding whether it was advisable to wind up or continue. Some speakers advised immediate liquidation, but others advocated continuing until things improved, particularly as they were paying their way and even earning a dividend.

The retiring director (Mr. Baker) was re-elected, as was also the auditor.

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## The Electric Construction Company, Limited.

THE fifth annual general meeting of the shareholders of the above company was held on Thursday, July 21st, at Winchester House, Old Broad Street, Sir Daniel Cooper, Bart., in the chair.

The report having been taken as read, the CHAIRMAN said:—Gentlemen: The volume of our business has, during the past year, greatly increased, but the profit has not increased in equal proportion—a result due partly to higher prices for labour and material and partly to the fact that a considerable portion of our year's work has been the equipment of central station installations, under contracts entered into in the early part of last year, when competition was very keen. Even in the best of times the profit on this class of work frequently proves disappointing. Such, at least, has been our experience, and we intend to profit by it and provide in future tenders for this class of work ampler margin than heretofore for risk and profit, a course which it is hoped will be followed by other manufacturers. As matters stand we have earned enough to pay a 6 per cent. dividend and to add something to the reserve, besides, of course, paying the full dividend on the preference shares. We have also more than maintained our reputation for excellence in design and skill in workmanship, and thereby improved the company's position and strengthened our connections. The manufacture of electrical machinery is a comparatively new business, and there is in consequence continuous development towards a higher standard of efficiency and greater economy in the production of existing machines, as well as in designing novel types adapted to new purposes. These objects consume a good deal of extra time both in design and construction, without yielding in the first instance adequate return, and as we have been to a larger extent than usual engaged on such work during the year, this fact doubtless explains to some extent why our profits have not increased in proportion to our business. But such enterprise is necessary to maintain our position in the front rank of the industry, and lays the foundation for enlarged business and better profits in the future. For some time past we have stiffened our prices, and yet we have orders for extensions of recently completed central stations and for the electrical equipment of the City and South London Railway extensions sufficient to keep our works employed as long ahead as we care to engage ourselves, in fact, I may tell you that our works are full of orders for the next six months. We had no trouble at Bushbury during the protracted and disastrous strike of the engineers, and I have much pleasure in acknowledging the loyalty of our men. But, although the strike caused us no direct loss, our business suffered to some extent indirectly. Central station installations require boilers and engines, as well as dynamos, transformers and switchboards, and in consequence of the strike, the completion of our part of the installations was greatly delayed, and delay always means loss to the contractor as well as annoyance to the customer. We endeavour in our relations with our men to interest them in the company's prosperity by giving them a share of the profits earned, hoping to stimulate efficiency by giving the men reason to feel that they themselves will profit by industrious co-operation with the management. This policy, we believe is appreciated. There is certainly harmonious co-operation among all departments of the works, and, as I have already told you, our engineers stood loyally by us during the strike. We do not think that the Workmen's Compensation Act, which came into effect on the first of this month, will involve the company in serious expense. Our works are new, and the comfort and safety of the employés were carefully considered in their construction. Our men in consequence enjoy exceptionally good health, and during the four years of the present management there has been no serious accident. May our good fortune long continue. We do not, therefore, propose to meet our liability by insurance with any company, but to be our own underwriters, appropriating yearly out of profits such sum as may be considered sufficient to meet the claims under the Act. Turning now to the statement of accounts, you will observe that we propose to make an alteration in the form of our depreciation and reserve accounts. It seemed to us that the general accounts could be simplified, and the position made more evident by combining these two accounts; and therefore, after providing £5,000, as usual, for depreciation out of the income of the year, we propose to unite both accounts into one general reserve and depreciation fund, which will, if you approve, appear in next year's accounts with a credit balance of £40,000. The only other item to which I invite your attention is the "shares and debentures of other companies," amounting to £124,494 3s. These figures are almost the same as last year, but since the accounts were closed, £20,000 worth of the shares have been sold at something over the figure at which they stand in the balance-sheet, and the amount at debit of this account is now reduced by that amount. Much the larger proportion of this account consists of our holding in the Electrical Power Storage Company, a company organised by the old Electric Construction Corporation to take over its accumulator business, which was carried on in connection with, but not at, the Wolverhampton works. Experience, however, had proved that the manufacture and sale of accumulators could not be advantageously carried on by the Wolverhampton staff, because the accumulator works are situate at Milwall, in London, and also for other reasons. The Electrical Power Storage Company was, in consequence, organised to take over this portion of the corporation's business, and has proved a success, for it has paid a regular dividend of 5 per cent. in each of the last seven years, and as its business continues to develop and its manufactures hold the leading position in the market, it is reasonable to expect that the business will yield improved results in future. But it will no doubt suggest itself to you, as it does to the board, that it might be well to reduce our large holding in that company, and we therefore contemplate, when more capital is required by the growth of our Bushbury business, as no doubt will soon be the case, to offer a portion of our holding in the Electrical Power Storage Company to our shareholders at such price as its position and prospects may seem to justify. You will probably recollect that at our meeting last year you were informed that your directors contemplated a readjustment of the company's debenture debt, and I am happy to report that our ideas have been successfully carried out. The 6 per cent. debentures due in 1901 have, by the payment of a moderate premium, been converted into a 4 per cent. debenture stock, and the cost of the conversion has been paid out of the premiums received on the preference shares issued last year, and a surplus of £2,524 18s. 3d.

left, which, as the accounts show, has been carried to profit and loss account. The conversion from 6 per cent. debenture to 4 per cent. debenture stock will save to the company about £3,000 per annum of interest payable, and this reduction, coupled with the increased output at the works we look for, will in future prove a substantial relief to the burden of our standing charges. In conclusion, I am happy to believe that the company's position is steadily improving year by year, and to entertain the hope that your directors will be able to report a further improvement at the next annual meeting. I now beg to move: "That the accounts and the report, with the recommendations therein contained, submitted by the directors, be approved and adopted."

Sir Henry C. Mance, C.I.E., seconded the motion.

Mr. Saward proposed as an amendment to the report that the dividend be paid in full at once instead of a half of the payment being postponed until January 31st next.

Mr. Gillespie seconded the amendment, which, however, was rejected by the meeting, and the report was adopted.

The retiring directors and auditors having been re-elected, the proceedings terminated with a vote of thanks to the chairman for presiding.

## The Edison and Swan United Electric Light Company, Limited.

The fifteenth annual report for the business year ending June 30th, 1898, states that the profit and loss account shows a credit balance of £43,040 17s. Providing for the interest upon the debenture stock, there remains a balance of £35,587 7s. 7d. available for distribution. An interim dividend at the rate of 5 per cent. per annum having already been paid in respect of the half-year ending December, 1897, a further payment at the rate of 7 per cent. per annum for the second half is recommended, making the dividend for the book year 6 per cent. per annum, the balance of £12,578 14s. being carried forward, as against £8,493 7s. 6d. in the preceding year. The business of the company has continued to develop, and besides the large extensions of premises and plant at the Ponder's End works, it has been found necessary to make others. The factory at South Benwell, which has been unoccupied for a considerable time, has been refitted with machinery of the latest invention and re-opened as a lamp factory. A brass finishing factory at Walsall has been acquired for the manufacture of electrical fittings. The Broadheath factory (taken over from the Manchester Edison-Swan Company) is now turning out dynamos, motors, and other machinery used for electrical plant. In order to meet the expenditure consequent upon these large extensions, and to make provision for much larger stocks of lamps, fittings, and appliances at the numerous depôts of the company, it has been determined to issue shortly a further £100,000 of the company's 4 per cent. debenture stock. Mr. Ernest Villiers and Major Flood Page retire by rotation from the board, and offer themselves for re-election. Messrs. Welton, Jones & Co., the auditors, offer themselves for re-election.

## City and South London Railway Company.

The twenty-eighth ordinary general meeting of the proprietors of this company was held on Tuesday at the offices, 46, King William Street, Mr. C. G. Mott in the chair.

The Chairman, in moving the adoption of the report, said he was pleased to be able to congratulate the shareholders upon the steadily improving position of the company as regarded its dividends. The dividend they recommended on the present occasion was 2½ per cent. per annum on the ordinary stock, being the highest dividend they had yet paid. The steady progress which the line had made from the beginning was a very satisfactory feature in it, and it was a feature which essentially belonged to electric railways. Having but one centre from which the power was distributed, the expenses of working a line of that kind did not increase in the same way as the expenses of an ordinary steam railway, in proportion to the traffic carried; in fact, their expenses were not greater for the present year than they were the first year the line was opened, although their actual receipts had increased very nearly 50 per cent. The consequence was, that with a fixed expenditure and considerably increased receipts, they had been able to improve their position year after year and pay increased dividends, and although the profits did not yet come up to anything like the figure which they hoped they would do, they had little doubt that in the future the progress which they had seen in the past would be steadily continued, and that the line would attain a position of undoubted financial prosperity in the future. In the corresponding half of last year they had the advantage of a somewhat severe winter, followed by the special receipts obtained through the Jubilee celebrations, and consequently they had an exceptionally large increase of traffic in those six months. This half-year, although they had had a mild winter, which was very much against the traffic on their line, and no extraordinary receipts, they had been able to maintain the same amount of income that they received in the corresponding six months. That was a very satisfactory result, as it showed that the traffic on the line was growing regularly and steadily. They had carried 41,167 more passengers, and although the receipts showed a slight decrease of £54, that was accounted for by the fact that in the corresponding period the fares were raised during Jubilee week, and therefore they took more money while carrying a fewer number of passengers. There had been an increase of mid-day passengers, who travelled short distances, which was a very satisfactory feature of the past half-year. The trains had always been crowded of a morning and evening, but during mid-day they had only been sparsely filled. The mid-day traffic would undoubtedly increase as they got their extensions open. The first one to Moorgate Street was progressing very satisfactorily. One of the tunnels between Moorgate Street station and the station at Lombard Street was now completed, the other tunnel was following fast upon it, and would be completed within the next month or so. The station tunnels at Moorgate Street were completed, and those at Lombard Street were practically completed. The line between the Lombard Street station and the station on the other side of the river at Denman Street, Boro,' was being completed, and one of the tunnels would within a month be completed up to the corner of Lombard Street, so that within a month from now they expected to have one of the tunnels absolutely complete from end to end. The station tunnels at Denman Street were also making rapid progress, and within three months from now they expected that the whole of the tunnelling work in connection with the line would be finished. Of course there was a good deal of work which would still remain to be done, but he believed that the extension would be completed within the contract time. Coming to the question of the church of St. Mary Woolnoth, that was a very difficult work and very slow work. The church was now standing entirely supported upon girders, and the work had been so admirably carried out that not a single crack in the structure had taken place—a fact which, he thought, spoke exceedingly well both for their engineers and contractors. Arrangements had been completed with the Central London Railway to connect their station at the Bank with their Lombard Street station. As regarded the Clapham extension, the contract had been let, and the works were already in active progress. All the property required had been acquired and paid for, so that they had every expectation that some time next year they would have the entire railway opened for traffic from the Clapham end to Finsbury Pavement. As regarded the City and Brixton Railway, a Bill had been introduced into Parliament, and arrangements were now being carried out by the company for the raising of the necessary capital, so as to proceed with the work as soon as possible. Having referred in detail to the accounts, the chairman said that the working expenses of the line were down from 57·62 to 56·67, and the expenses per train mile from 1s. 4·22d. to 1s. 3·92d. Locomotive expenses had been reduced from 6d. to 5·8d., and traffic expenses from 6·25d. to 6·03d., so that they were steadily reducing their expenses and increasing their receipts. The first year, when the line was opened, the working expenses were 79·7d, while last year they were only 56·67d. Electric railways had yet to establish themselves with the financial public, but he did not think there could be any doubt that in the future they were destined to form one of the safest and soundest investments that could be found in the country.

Mr. Sampson Hanbury seconded the motion, and the report was adopted.

## Globe Telegraph and Trust Company.

The twenty-fifth ordinary general meeting of the shareholders of the above company was held on Tuesday last at Winchester House, Old Broad Street, the Marquis of Tweeddale in the chair.

In moving the adoption of the report, the Chairman, after referring with regret to the death of Lord Sackville Cecil, said the year which had come to a close on the 18th inst. had been a very prosperous one. The receipts, after deducting all expenses, amounted to £196,974, an increase of £10,392 over the previous year. The ordinary expenses of the company were always very small, and as a matter of fact they were £50 less last year than in the preceding year. During the last few years the directors had steadily pursued the policy of distributing the company's investments over a larger area, thus carrying out the original principles of the company, which was to spread the risk in somewhat equal proportions over the various prosperous telegraphic companies of the world. When he addressed them last year, he expressed the opinion that the changes which they were making would improve the financial position of the trust, and events had fully justified that statement. The result had been, that already they had received 6d. per share in interim dividends, and there was now an available balance sufficient to pay a dividend of 4s. 3d. per share as against 3s. 6d. last year. In other words, the directors were able to recommend, in addition to the usual 6 per cent. on the preference shares, a dividend on the ordinary shares of 5½ per cent. for the current year as against 4½ per cent. for the past year, and also to carry forward a balance of £2,225—or within a few pounds of another ½ per cent. He then referred to the various changes which the directors had made in their investments during the year, and, in reference to the Western Brazilian Telegraph Company, he said they now came to an interesting company—the Western Brazilian Telegraph Company—and as they would see from the report, they had considerably increased their holding in all classes of that company's shares. The directors considered that that was a very good investment, especially in view of the fact that a new arrangement had been practically arrived at between the Western Brazilian Telegraph Company and the Brazilian Submarine Telegraph Company. With respect to that arrangement, he might mention that the terms received very full consideration from the directors, and they were of opinion that it was an exceedingly fair and equitable solution of a very difficult problem. As regarded the deferred shares, they had no reason whatever to complain as to what they would receive under the arrangement, and no better evidence could be given that it could not be anything but a very reasonable agreement than the fact that some months ago, before the arrangement was thought of, the shares were down to something like £2, whereas now they stood at about £5. They were perfectly satisfied with the terms of the arrangement that had been entered into between the two companies. The dividends received from the Western Brazilian Telegraph Company last year were not very large, but this year they had received the full 5 per cent. and arrears on the preferred, and ½ per cent. on

the deferred; the result being that they had received from the company in dividends in the year under review £5,644, as against £1,946 last year. They had also acquired 218 more of their 4 per cent. debentures, which investment added £1,279 to their income as against last year. He regretted to say that they were still without any dividend on the ordinary stock which they held in the West Coast of America Telegraph Company. On the whole, the year just closed had been one of the best years the company had ever had. Indeed, only on two occasions—in 1873, when they paid 5½ per cent., and in 1891, when they paid 5½ per cent.—had the dividend been larger than on the present occasion, a result which, he thought, would be considered very satisfactory by the shareholders. Not only had the dividend been increased, but the value of the stocks and shares held by the company was also increased, and stood higher to-day in the market than it had ever done in the history of the company. The capital of the company was £3,602,690, but the value of the securities they held represented no less a sum than £4,703,456, taking the middle market prices—which showed a profit over the cost of £1,449,790. That was the twenty-fifth year of the company's existence, and the one-hundredth dividend that had been declared, and he (the chairman) thought he was right in saying that he had been present at every meeting of the company since its formation. He had every reason to hope that when he had the pleasure of meeting the shareholders next year, he might have an even more favourable statement to make.

Sir J. PENDER seconded the motion, and the report was adopted.

## Crompton & Co., Limited.

MR. JOHN TROTTER (chairman) presided, on Thursday in last week at the Cannon Street Hotel, over the annual general meeting of the above company, and in moving the adoption of the report, said he would like to say a few words as to the present position of the company compared with the date of the fire two years ago. At that time the fire had destroyed the greater part of their works and had seriously interfered with the carrying on of the business at Chelmsford. At the same time they were suffering from heavy claims which were made upon the company by various subsidiary departments, which acted as a considerable drain upon its resources. It was also well known to everybody that a considerable amount of capital had been lost, and was not properly represented by the assets. He promised at that time that the board would endeavour to put those matters right. The remedies they proposed were, in the first place, to rebuild their works; in the second place, to concentrate the business into the two principal departments of contract and manufacture; thirdly, to bring forward a scheme for the reduction of capital in order to put the balance-sheet in a proper condition; and fourthly, to effect such economies as would bring the business into a dividend-paying position again. They now came before the shareholders to give some account of their stewardship. As regarded the works, with his usual energy, Mr. Crompton, assisted by Mr. Brunton, the manager of the Chelmsford works, started to work out a scheme for the best possible building that would be adapted for carrying out the large amount of work which now came to the company. Those plans had been carried out in the completest possible manner. The works were well equipped—he would not say fully equipped—for they had refrained from getting some things in consequence of the cost which had been incurred. He had the authority of one of the greatest electrical authorities of the day in saying that the new works were second to none for the purposes for which they were required in the country and probably in the whole world. Two years ago they had a cooking and heating department, involving heavy annual expenditure. Then they had a subsidiary company for the manufacture of ornamental iron work, which was a heavy drain on the company's resources, and in addition they had a business in the south of England which, although not losing money, took up a great deal of time. There was also an electric wiring business, which was also a source of considerable loss of energy in the management of the company, and in Australia they had a very heavy commitment where there was a great temptation to throw good money after bad. He was pleased to tell them they had got rid of every one of them. They had not slaughtered those departments, but they had realised in many cases advantageously. The leakages, however, had been absolutely stopped with regard to all those things, and that was a very satisfactory thing. Then with regard to the capital, every one present was acquainted with the scheme which had been carried through, and which had enabled them to get rid of the preference shares, which were little different to founders' shares, at a price something like 40 per cent. discount on their value. They had introduced economies into the business as far as possible. There was no doubt that while in the past the technical side of the business had been developed to the very highest state of efficiency the business side had got somewhat into confusion. It was considered desirable to define more distinctly the two departments, and they decided to appoint a business manager who should not be on the board of directors, over whom they would have control. Fortunately they had at hand a gentleman well qualified for the responsible position, and their appointment of Mr. Reeves had been fully justified. He would like to draw their attention to the ratio of expenses in profit and loss, to gross profits earned by the company. Before the fire they bore the ratio of 77½ per cent, and in 1897 they were reduced to 72½ per cent. In the year under notice they were still further reduced to 67 per cent. The gross profit was £41,418; so that the reduction was practically equivalent to the balance they carried forward that year. Dealing with the profit and loss account, the chairman said the loss to the company from the strike was £450. The gross profit was £41,418 against £42,290, but there was an increase in the net profit from £12,172 to £13,568. In the past year they had had the strike and the removal, and their machines had been employed in making new machinery for the new works. He had every reason to believe that they would now do much better. Proceeding to deal with the balance-sheet, the chairman said the increase in the loans was accounted for by the cost of establishing the new works. There was an immense development of electric work in the country now local authorities were awakening to the advantages of electric light, and there was a great movement in favour of electric traction, which must mean an immense amount of work for somebody, and he had no hesitation in saying that Crompton's would have their share, and would be able to do it at a profit. The Chelmsford Electric Light Company was becoming a valuable property, and he would like to keep it for Crompton's, but it was not their business to keep a large amount of money locked up when they wanted it, and therefore the directors thought there would be no difficulty in disposing of the company at a satisfactory figure, which would enable them to reduce the loans to a point which would give them no further anxiety.

Replying to various questions, the CHAIRMAN said the figure of £14,673 which stood in the balance-sheet for the Chelmsford Electric Light Company did not in any way represent the value, but he would not mention the exact sum. They believed now, for the first time, that the cooking apparatus was going to pay. Directly they had satisfactorily dealt with the loans they would consider about a dividend.

Mr. R. E. B. CROMPTON seconded the motion, and said that the figure mentioned by the chairman did not anything like cover the loss to the company by the strike, for it had lost them about two months' output. Still, as the result of not giving way, they had now a very happy family at Chelmsford.

The report was then adopted.

## Anglo-American Telegraph Company, Limited.

THE report of the directors to be presented to the half-yearly meeting of the proprietors, to be held at Winchester House, 50, Old Broad Street, London, on Friday, July 29th, 1898, at 2 o'clock p.m., states that the total receipts from January 1st to June 30th, 1898, including the balance of £209 16s. 6d. brought forward from the last account, amounted to £196,196 12s. 8d. The traffic receipts show an increase of £24,305 as compared with the half-year ended June 30th, 1897. The total expenses of the half-year, including the repair of cables, &c., as shown by the revenue account, amounted to £61,616 6s. 6d., being an increase of £8,315 2s. 8d. over the corresponding period of 1897. The directors, under the powers conferred upon them by the articles of association, have, before declaring the net profits, set apart the sum of £12,000 to the renewal fund, leaving a balance of £122,580 6s. 2d. One quarterly interim dividend of 15s. per cent. on the ordinary stock, and of £1 10s. per cent. on the preferred stock, was paid on April 30th, 1898, absorbing £52,500, and a second quarterly dividend of 15s. per cent. on the ordinary stock and £1 10s. per cent. on the preferred stock, amounting to £52,500, will be paid on August 2nd, 1898. The balance of £17,580 6s. 2d. will be carried forward to the next account. The cables and landlines of the company are in good working order.

## Central London Railway Company.

THE report for the past half-year states that the expenditure in that time amounted to £466,560, making the total outlay on capital account £2,073,508. Good progress has been made with the tunnelling, which, with the exception of the portion eastward of Chancery Lane, is well advanced. The operations at the Bank station have presented great difficulties and caused considerable delay, but the large gas and water mains which intersected the area have now been removed and replaced in a new subway provided by the company for their reception. The underground works at this point are being pressed forward, and two out of the five lift shafts are nearly completed. The power station and carriage and engine sheds at Shepherd's Bush are in course of erection, and the manufacture of the electrical plant is well advanced. The whole of the share capital being now issued, it is proposed to obtain authority to issue debenture stock bearing interest at 4 per cent.

## New Electricity Supply Syndicate, Limited.

AN ordinary meeting of this company was held at Winchester House on Monday. Lord Lurgan, who presided, said they had no report or accounts to submit on that occasion, which was simply their statutory meeting. The syndicate was formed to secure Mr. Rowbotham's patents for his primary generator, and they had acquired the contract for the purchase of all his patents for all the principal countries of the world, but the date for completing the purchase had not yet arrived. They had had reports on the invention by Prof. Silvanus Thompson and Mr. Haydn T. Harrison. In Prof. Thompson's first or original report he said, referring to primary cells or batteries:—"I have found no cell that would give one Board of Trade unit at a lower cost than 1s. 3d."; but he concluded this report by certifying that the Rowbotham generator could produce a Board of Trade unit at 6¾d. In a supplementary report, Prof. Thompson brought the price down to 6¼d. They had every reason, however, to believe that they would get the price considerably below this when certain improvements and alterations suggested by Mr. Rowbotham and Mr. Harrison had been carried out. Referring to the advantages which they claimed for the invention, Lord Lurgan stated that they would possess the only generator that could efficiently generate electrical energy without the use of moving machinery. The fuel—or, he should call them, the

active materials of their generator—was cheap, and could be obtained in unlimited quantities. The generator was, he said, automatic, and it required no skilled labour; and anybody, poor or rich, would be able to light his house with electricity. Early in the autumn it would be necessary to form a company with a large working capital to carry out the manufacture and supply of the generators.

## Direct United States Cable Company.

The ordinary general meeting of the Direct United States Cable Company, Limited, was held at Winchester House on Tuesday, under the presidency of Mr. E. M. Underdown.

The Chairman, in moving the adoption of the report and accounts, said they would remark that the revenue for the six months ending June last amounted to £52,233, while the working and other expenses, including income-tax, but excluding the cost of repairs of cables, amounted to £21,695, leaving a balance of £30,546 as the net profit, which, with £4,090 brought forward from the previous half-year, made a total of £34,637. The revenue was £8,340 more favourable than in the corresponding half of last year. This was no doubt owing in part to exceptional causes—to warlike causes; and as people sometimes profited by the misfortunes of others, so the telegraph companies had benefited in the circumstances. The usual details of expenditure were furnished in the accounts. The working expenses and other payments amounted to £18,559. Three quarterly interim dividends of 5s. each per share, amounting to £27,319, had been paid, and a final dividend of 3s. per share would be proposed, together with a bonus of 1s. per share, making, with the interim dividends, 3½ per cent. for the year, making a total distribution of £39,461. There was £10,000 transferred to the reserve fund account, and the balance of £3,389 would be carried forward. They had effected certain improvements in providing duplex working, and the automatic working of the landline, and there was an increase in the items of repairs and renewals and buildings. The question of repairs was important, and the item had been considerable during the last year. There were one or two repairs which had been extremely serious; but the reserve fund account had been debited with £8,260 for cost of cable repairs, and with £2,000 written off the Ballinskilligs buildings account, the balance of the reserve fund now amounted to £351,455. Their repairs had to be carried on as the necessity arose, and occasionally they were very heavy, but by the principle they adopted, the payments were equalised from half-year to half-year. This enabled them to ensure continuity in dealing with the funds of the company.—The report was adopted.

## Prospectuses.

At the end of last week the prospectus was issued of the Wenlock Electrolytic Company, Limited, which has been formed to acquire a process for the manufacture of chlorate of soda and potassium, and to establish the business of manufacturers of various commercial products capable of being manufactured by electricity or electro-chemical means. The works will be erected on a coalfield, where a good supply of water is available, within a mile of Horsehay Station on the Great Western Railway. It is intended by the company to put down at once a plant of 2,000 horse-power for the production of electricity, and to erect further plant up to 3,000 horse-power as the industry progresses. With an installation of 3,000 horse-power, a profit is anticipated of about £25,000 a year. The capital of the company is £120,000, divided into 120,000 shares of £1 each. The directors are Lord Forester, the Hon. George Forester, Mr. William Wright, of Nottingham, and Mr. Thomas Parker, of Tettenhall.

The Electro-Chemical Company, Limited, of St. Helens, are understood to be inviting applications for £40,000 6 per cent. first mortgage debentures. Prospectuses are to be obtained on application to the company.

We are pleased to see that the Great Northern and City Electric Railway Company which has been twice before the public, but was not taken up, has this week been brought out again. The contractors agreed to guarantee minimum dividends of 4 per cent. on the "A," and 3 per cent. on the "B" shares for the three years, during which they will operate the line after completion, and 3 per cent. will be paid on both classes during construction.

The Hampstead Electric Supply Company, which has an authorised capital of £200,000 is before the public, the list closing to-day, Friday. 13,334 5 per cent. preference and 13,334 ordinary shares, all of £5 each, are offered for subscription. The company is to acquire the London and Hampstead Battery Company, which for the past six years has been supplying current for lighting houses, flats, and shops in the district of Hampstead. The prospectus states that "the company is in the strong position that it cannot be interfered with by the local authorities in the way of compulsory purchase, as the powers conferred by the Electric Lighting Acts on public authorities do not apply to this undertaking. The company's system of supply of low pressure continuous current by overhead wires enables it to give that supply over a very extended area at a minimum cost, as compared with underground wiring, the actual saving in material alone amounting to over £1,000 per mile, apart from the heavy cost involved in the laying of culverts to carry the mains, and the ever-recurring expense of opening the roadways for maintenance and repair." A report by Prof. S. P. Thompson on the prospects of the company is reprinted in extract in the prospectus. The company will equip a motor car charging station upon his recommendation, and arrangements have been made for the supply of motor cars to the company, who will let them out on hire, several contracts having been already entered into. The purchase price for the freehold and leasehold premises, cables, plant, machinery, rolling stock, contracts, horses, carriages, and all other assets of the existing business and undertaking, has been fixed by the vendor at £165,000, payable as to £33,330 in fully-paid ordinary shares, as to £33,330 in fully-paid preference shares, and as to the balance of £98,340 in cash, or partly in cash and partly in fully-paid shares. The profits are estimated at £18,332 odd, so that after paying £5,000 for preference interest, and allowing a proposed 7 per cent. on the ordinary shares (£7,000), a surplus of £6,332 remains for management, reserve fund, depreciation, &c. The directors are W. P. James Fawcus, M.I.C.E., M.I.E.E., director Edison & Swan United Electric Light Company, Limited, Dartmouth House, Queen Anne's Gate, S.W.; J. Soares, director Richmond (Surrey) Electric Light and Power Company, Limited; E. Jarvis Cave, builder, Hampstead, N.W.; Arthur Watling, director Globe Venture Syndicate, Limited; D. H. Evans, director D. H. Evans & Co., Limited, Oxford Street, London, W.; and A. W. Armstong, Hampstead (late managing director London and Hampstead Battery Company, Limited), managing director, who will join the board after allotment. The secretary (*pro tem.*) is Mr. C. A. Goffin, 34, Ely Place, Holborn, E.C.

Our opinion of the prospectus is that there is an ambiguity in the sums put down for profits, and no information is given concerning the business of Taylor & Lown, which is being acquired for the motor car branch of the company. We consider the sum to be paid to the vendor excessive. In regard to the report of Prof. Thompson, to which we refer above, this is little more than a description of the works of the company. We must confess that we are not impressed with these shares as an investment.

**W. T. Henley's Telegraph Works Company, Limited.**—The directors have declared the following interim dividends payable on September 1st, 1898, for the half-year ending June 30th, 1898:—On the preference shares at the rate of 7 per cent. per annum (less income-tax); on the ordinary shares at the rate of 8 per cent. per annum (less income-tax).

**The Charing Cross and Strand Electricity Supply Corporation, Limited.**—The directors, after paying interest on debentures, making provision for dividend on 4½ per cent. cumulative preference shares, have declared an interim dividend for the half-year ended June 30th, 1898, at the rate of 6 per cent. per annum on the ordinary share capital of the Corporation, and have carried forward £7,400. The interim dividend will be paid on August 1st next.

**Telegraph Manufacturing Company.**—In our notes last week on the prospectus of this company we stated that £100,000 was paid to the vendor in cash and the remainder in shares. This, as will have been seen from the prospectus, should read £94,000 in cash and £66,000 in shares. This sum provided for the purchase of all the assets, including book debts, the total being £149,528.

**The London Electric Supply Corporation, Limited.**—Letters of allotment and regret in connection with the issue of £200,000 4 per cent. first mortgage debenture stock of the London Electric Supply Corporation, Limited, have been posted. The issue was offered to the shareholders of the company only, and was very largely over-subscribed.

**British Aluminium Co.**—The general meeting of this company was held on Thursday at the Westminster Palace Hotel. Mr. R. W. Wallace, Q.C., presided. Mr. Bolton seconded the adoption of the report which was carried. A report of the meeting will appear next week.

**National Telephone Company.**—The meeting of this company was held on Wednesday, at Cannon Street Hotel, but pressure upon our space compels us to hold our report over until next week.

## TRAFFIC RECEIPTS.

The Bristol Tramways and Carriage Company, Limited.—The receipts for the week ending July 22nd, 1898, were £3,047 7s. 2d.; corresponding period 1897, £2,707 14s. 11d.; increase, £339 12s. 3d.

The City and South London Railway Company.—The receipts for the week ending July 24th, 1898, were £935; week ending July 25th, 1897, £898; increase, £46; total receipts for half-year, 1898, £3,763; corresponding period, 1897, £3,666; increase, £97.

The Dover Corporation Electric Tramways.—The receipts for the week ending July 23rd, 1898, were £203 2s. 4d.; total receipts to July 23rd, 1898, £3,834 0s. 10d.

The Dublin Southern District (Electric) Tramways Company.—The receipts for the week ending July 22nd, 1898, were £1,264 14s.; corresponding week last year, £912 16s. 10d.; increase, £351 17s. 2d.; passengers carried, 173,563; corresponding week last year, 127,687; aggregate to date, £3,261 15s. 2d.; aggregate to date last year, £2,648 16s. 7d.; increase to date, £612 18s. 7d.; mileage open, 9 miles, as against 8 miles for the corresponding period of last year.

The Liverpool Overhead Railway Company.—The receipts for the week ending July 24th, 1898, amounted to £1,652; corresponding week last year, £1,472; increase, £180.

The Western and Brazilian Telegraph Company, Limited.—The receipts for the week ending July 22nd, 1898, after deducting 17 per cent. of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited, were £2,780.

## SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

| Present Issue. | NAME. | Stock or Share. ‡ | Dividends for the last three years. 1895. | 1896. | 1897. | Closing Quotation, July 20th. | Closing Quotation, July 27th. | Business done during week ended July 27th, 1898. Highest. | Lowest. |
|---|---|---|---|---|---|---|---|---|---|
| 137,400£ | African Direct Telegraph, 4 % Debs. ... ... ... | 100 | 4 % | ... | ... | 99 —103 | 99 —103 | ... | ... |
| 25,000 | Amazon Telegraph, shares ... ... ... ... ... | 10 | ... | ... | ... | 6 — 7 | 6 — 7 | ... | ... |
| 125,000 | Do. do. 5 % Debs. Red. ... ... ... ... | 100 | ... | ... | ... | 92 — 95 | 92 — 95 | ... | ... |
| 923,960£ | Anglo-American Telegraph ... ... ... ... ... | Stock | £2 9s | £2 13s | 3 % | 64 — 67 | 64 — 67 | 65½ | 65 |
| 3,038,020£ | Do. do. 6 % Pref. ... ... ... | Stock | £4 18s | £5 6s | 6 % | 116 —117 | 116½—117½ | 117⅜ | 116¼ |
| 3,038,020£ | Do. do. Deferred... ... ... ... | Stock | ... | ... | ... | 15½— 16 | 15½— 16 | 16⅛ | 15⅝ |
| 130,000 | Brazilian Submarine Telegraph ... ... ... ... | 10 | 7 % | 7 % | 7 % | 15⅝— 16¼ | 15⅝— 16¼ | 16 | 15⅞ |
| 75,000£ | Do. do. 5 % Debs. 2nd series, 1906 ... | 100 | 5 % | ... | ... | 111 —115 | 111 —115 | ... | ... |
| 44,000 | Chili Telephone, Nos. 1 to 44,000 ... ... ... ... | 5 | 4 % | 4 % | ... | 2¾— 3¼ | 2¾— 3¼ | ... | ... |
| 10,000,000$ | Commercial Cable ... ... ... ... ... ... | $100 | 7 % | 8 % | 8 % | 180 —190 | 180 —190 | ... | ... |
| 918,297£ | Do. do. Sterling 500 year 4 % Deb. Stock Red. | Stock | ... | ... | ... | 104 —106 | 103 —105 | 104½ | 103½ |
| 224,850 | Consolidated Telephone Construction and Manufacturing | 10/- | 1½ % | 2 % | ... | 1/16— 3/16 | 1/16— 3/16 | ... | ... |
| 16,000 | Cuba Telegraph ... ... ... ... ... ... ... | 10 | 8 % | 8 % | 7 % | 7 — 8 | 7 — 8 | ... | ... |
| 6,000 | Do. 10 % Pref. ... ... ... ... ... ... | 10 | 10 % | 10 % | 10 % | 15 — 16 | 15 — 16 | ... | ... |
| 12,931 | Direct Spanish Telegraph ... ... ... ... ... | 5 | 4 % | 4 % | 4 % | 4 — 5 | 4 — 5 | ... | ... |
| 6,000 | Do. do. 10 % Cum. Pref. ... ... | 5 | 10 % | 10 % | 10 % | 10 — 11 | 10 — 11 | ... | ... |
| 30,000£ | Do. do. 4½ % Debs., Nos. 1 to 6,000 ... | 50 | 4½ % | 4½ % | 4½ % | 102—105% | 102 —105% | ... | ... |
| 60,710£ | Direct United States Cable ... ... ... ... ... | 20 | 2¼ % | 2½ % | ... | 11 — 11½ | 11¼— 11⅜ | 11⅜ | 11 5/16 |
| 120,000 | Direct West India Cable, 4½ % Reg. Deb. ... ... | 100 | ... | ... | ... | 100—103 | 100 —103 | 101½ | ... |
| 400,000 | Eastern Telegraph, Nos. 1 to 400,000 ... ... ... | 10 | 6½ % | 6½ % | 7 % | 17¼— 17¾ | 17⅛— 18 | 17 1/16 | 17⅛ |
| 1,295,000 | Do. 3½% Pref. Stock ... ... ... ... | 100 | ... | ... | ... | ... ... | 101 —105 | 103½ | ... |
| 89,900 | Do. 5 % Debs., repayable August, 1899 ... | 100 | 5 % | 5 % | 5 % | 101 —104 | 101 —104 | ... | ... |
| 1,302,615£ | Do. 4 % Mort. Deb. Stock Red. ... ... | Stock | 4 % | 4 % | 4 % | 123 —127 | 123 —127 | 123½ | ... |
| 250,000 | Eastern Extension, Australasia, and China Telegraph ... | 10 | 7 % | 7 % | 7 % | 17¼— 17⅜xd | 17¼— 17⅜ | 17⅝ | 17⅜ |
| 25,200£ | Do. 5 % (Aus. Gov. Sub.) Deb., 1900, red. ann. drgs., reg. 1—1,049, 3,976—4,326 | 100 | 5 % | 5 % | 5 % | 98 —102 | 98 —100 | ... | ... |
| 100,500£ | Do. do. Bearer, 1,050—3,975, 4,327—6,400 | 100 | 5 % | 5 % | 5 % | 99 —102 | 99 —102 | ... | ... |
| 320,000£ | Do. 4 % Deb. Stock ... ... ... ... ... | Stock | 4 % | 4 % | 4 % | 124 —128 | 124 —128 | ... | ... |
| 35,100£ | Eastern and South African Telegraph, 5 % Mort. Deb., 1900 red. ann. drgs., Reg. Nos. 1 to 2,343 | 100 | 5 % | 5 % | ... | 98 —103 | 98 —103 | ... | ... |
| 46,500£ | Do. do. do. to bearer, 2,344 to 5,500 | 100 | 5 % | 5 % | ... | 99 —102 | 99 —102 | ... | ... |
| 300,000£ | Do. 4 % Mort. Debs., Nos. 1 to 3,000, red. 1909 | 100 | 4 % | 4 % | ... | 102 —105 | 102 —105 | ... | ... |
| 200,000£ | Do. 4% Reg. Mt. Debs. (Mauritius Sub.) 1—8,000 | 25 | 4 % | 4 % | ... | 104 —107% | 104 —107% | ... | ... |
| 180,227 | Globe Telegraph and Trust ... ... ... ... ... | 10 | 4⅛ % | 4½ % | 4½ % | 11½— 12 | 11¾— 12¼ | 12⅛ | 11¾ |
| 180,042 | Do. do. 6 % Pref. ... ... ... | 10 | 6 % | 6 % | 6 % | 16½— 17 | 16¾— 17¼ | 17 | 16⅝ |
| 150,000 | Great Northern Telegraph, of Copenhagen... ... ... | 10 | 10 % | 10 % | 10 % | 29 — 30 | 29 — 30 | ... | ... |
| 160,000£ | Do. do. do. do. 5 % Debs. ... | 100 | 5 % | 5 % | 5 % | 102 —105 | 102 —105 | ... | ... |
| 97,000 | Halifax & Bermuda Cable, 4½% 1st. Mt. Dbs., w'n. 1-1,200, rd. | 100 | ... | ... | ... | 99 —103 | 99 —103 | ... | ... |
| 17,000 | Indo-European Telegraph ... ... ... ... ... | 25 | 10 % | 10 % | 10 % | 50 — 53 | 51 — 54 | 53½ | 52½ |
| 100,000£ | London Platino-Brazilian Telegraph, 6 % Debs. ... ... | 100 | 6 % | 6 % | 6 % | 108 —111 | 108 —111 | ... | ... |
| 28,000 | Montevideo Telephone, 6 % Pref., Nos. 1 to 28,000 ... | 5 | 4 % | 4 % | 4 % | 2¼— 2⅜ | 2¼— 2⅜ | ... | ... |
| 484,597 | National Telephone, 1 to 484,597 ... ... ... ... | 5 | 5½ % | 5½ % | 6 % | 5⅝— 5⅞ | 5⅝— 6⅛ | 6⅛ | 5⅞ |
| 15,000 | Do. 6 % Cum. 1st Pref. ... ... ... | 10 | 6 % | 6 % | 6 % | 15 — 17 | 15 — 17 | ... | ... |
| 15,000 | Do. 6 % Cum. 2nd Pref. ... ... ... | 10 | 6 % | 6 % | 6 % | 15 — 17 | 15 — 17 | ... | ... |
| 250,000 | Do. 5 % Non-cum. 3rd Pref., 1 to 250,000 | 5 | 5 % | 5 % | 5 % | 5⅜— 5⅝ | 5⅜— 5⅝ | 5⅜ | 5⅜ |
| 1,329,471£ | Do. 3½ % Deb. Stock Red. ... ... | Stock | 3½ % | 3½ % | 3½ % | 100—105 | 100—105 | 102½ | 101 |
| 171,504 | Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid | 1 | 5 % | 5 % | 5 % | ⅝— ¾ | ⅝— ¾ | ¾ | ⅝ |
| 100,000£ | Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000 ... | 100 | 4 % | 4 % | 4 % | 104 —107 | 104 —107 | ... | ... |
| 11,839 | Reuter's ... ... ... ... ... ... ... ... | 8 | 5 % | 5 % | 5 % | 8 — 9 | 8 — 9 | 8 1/16 | ... |
| 3,381 | Submarine Cables Trust ... ... ... ... ... | Cert. | ... | ... | ... | 136 —141 | 136 —141 | 140½ | ... |
| 58,000 | United River Plate Telephone ... ... ... ... | 5 | 4 % | 5 % | 6 % | 4¼— 4⅜xd | 4¼— 4⅜ | ... | ... |
| 146,733£ | Do. do. 5 % Debs. ... ... ... | Stock | 5 % | ... | ... | 103 —106 | 103 —106 | ... | ... |
| 15,609 | West African Telegraph, 7,501 to 23,109 ... ... ... | 10 | 4 % | *nil* | *nil* | 3½— 4½ | 3½— 4½ | ... | ... |
| 213,400£ | Do. do. 5 % Debs. ... ... ... ... | 100 | 5 % | 5 % | 5 % | 99 —102 | 99 —102 | ... | ... |
| 30,008 | West Coast of America, Nos. 1—30,000 and 53,001—53,008 | 2½ | ... | ... | ... | ¼— ⅜ | ¼— ⅜ | ... | ... |
| 150,000 | Do. do. 4% Debs., 1—1,500 gua. by Bras. Sub. Tel. | 100 | ... | ... | ... | 103 —106 | 103 —106 | ... | ... |
| 64,269 | Western and Brazilian Telegraph ... ... ... ... | 15 | 3 % | 2 % | 3¼ % | 12½— 13 | 12½— 13 | 12⅝ | 12½ |
| 33,129 | Do. do. do. 5 % Pref. Ord. ... ... | 7½ | 5 % | 5 % | 5 % | 8½— 9 | 8½— 9 | 8⅞ | 8½ |
| 33,129 | Do. do. do. Def. Ord. ... ... | 7½ | 1 % | *nil* | ½ % | 4 — 4½ | 4 — 4½ | 4⅝ | 4⅜ |
| 889,521 | Do. do. do. 4 % Deb. Stock Red. ... | Stock | ... | ... | ... | 103 —106 | 103 —106 | 106 | 105 |
| 88,321 | West India and Panama Telegraph ... ... ... ... | 10 | ⅛ % | 1 % | ¼ % | ½— ⅝ | ⅝— ⅞ | ¾ | ... |
| 34,563 | Do. do. do. 6 % Cum. 1st Pref. ... | 10 | 6 % | 6 % | 6 % | 8 — 8½ | 8½— 9 | 8 1/16 | 8⅜ |
| 4,669 | Do. do. do. 6 % Cum. 2nd Pref. ... | 10 | 6 % | 6 % | 6 % | 5 — 7 | 6 — 8 | 7 | ... |
| 80,000£ | Do. do. do. 5 % Debs., Nos. 1 to 1,800 | 100 | 5 % | 5 % | 5 % | 104 —107 | 104 —107 | ... | ... |
| 1,163,000$ | Western Union of U.S. Telegraph, 7 % 1st Mort. Bonds | $1000 | 7 % | 7 % | 7 % | 105 —110 | 105 —110 | ... | ... |
| 160,100£ | Do. do. do. 6 % Ster. Bonds ... | 100 | 6 % | 6 % | 6 % | 100 —105 | 100 —105 | ... | ... |

## ELECTRICITY SUPPLY COMPANIES.

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 30,000 | Charing Cross and Strand Electricity Supply ... ... | 5 | 5 % | 6 % | 7 % | 12½— 13 | 12½— 13½ | 13 | 12 |
| 20,000 | Do. do. do. do. 4½ % Cum. Pref. | 5 | ... | ... | ... | 5¾— 6¼ | 5¾— 6¼ | ... | ... |
| 26,000 | *Chelsea Electricity Supply, Ord., Nos. 1 to 10,277... ... | 5 | 5 % | 5 % | 6 % | 9 — 10 | 9 — 10 | 9¼ | 9 |
| 60,000 | Do. do. do. 4½ % Deb. Stock Red.... | Stock | 4½ % | 4½ % | 4½ % | 113 —115 | 113 —115 | ... | ... |
| 50,000 | City of London Electric Lighting, Ord. 40,001—90,000 ... | 10 | 5 % | 7 % | 10 % | 26 — 27 xd | 25½— 26½ | 26 | 25¼ |
| 10,000 | Do. Prov. Certs. Nos. 90,001 to 100,000 £5 ... | 10 | ... | ... | ... | 26 — 27 xd | 25½— 26½ | ... | ... |
| 40,000 | Do. 6 % Cum. Pref., 1 to 40,000 ... ... ... | 10 | 6 % | 6 % | 6 % | 16½— 17½xd | 16½— 17½ | 17 | 16⅞ |
| 400,000 | Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid | ... | 5 % | 5 % | 5 % | 125 — 130 | 125 —130 | 128¼ | ... |
| 30,000 | County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—30,000 | 10 | *nil* | *nil* | *nil* | 13½— 14½ | 13 — 14 | ... | ... |
| 10,000 | Do. do. do. Nos. 30,001 to 40,000 £6 paid. | 10 | ... | ... | ... | 9½— 10½ | 9½— 10½ | ... | ... |
| 20,000 | Do. do. do. 6 % Pref., 40,001—60,000 | 10 | 6 % | 6 % | 6 % | 14½— 15½xd | 14 — 15 | ... | ... |
| 17,400 | Edmundsons Elec. Corp., Ord. Shares 1—17,400 £6 paid | 5 | ... | ... | ... | 3½— 4½xd | 4 — 5 | 4⅜ | 4 5/16 |
| 10,000 | House-to-House Electric Light Supply, Ord., 101 to 10,100 | 5 | ... | ... | 4 % | 9½— 10½ | 9½— 10½ | 9¼ | .... |
| 10,000 | Do. do. 7 % Cum. Pref. ... | 5 | 7 % | 7 % | 7 % | 9½— 10½ | 9½— 10½ | ... | ... |
| 62,400 | *Metropolitan Electric Supply, 101 to 62,500 ... ... | 10 | 4 % | 5 % | 6 % | 17½— 18½ | 16 — 17 | 17⅜ | 16⅜ |
| 220,000£ | Do. 4½ % First Mortgage Debenture Stock | ... | 4½ % | 4½ % | 4½ % | 116 —120 | 116 —120 | ... | ... |
| 6,452 | Notting Hill Electric Lighting ... ... ... ... | 10 | 2 % | 4 % | 6 % | 16½— 17½xd | 15 — 16 | 16½ | 15½ |
| 31,980 | *St. James's and Pall Mall Electric Light, Ord. ... ... | 5 | 7½ % | 10½ % | 14½ % | 17 — 18 | 16 — 17 | 17½ | 16 5/16 |
| 20,000 | Do. do. 7 % Pref., 20,081 to 40,080 | 5 | 7 % | 7 % | 7 % | 9 — 10 | 9 — 10 | 9 9/16 | 9⅜ |
| 50,000 | Do. do. 4 % Deb. Stock Red. ... | Stock | ... | ... | 4 % | 105 —108 | 105 —108 | ... | ... |
| 43,341 | South London Electricity Supply, Ord., £2 paid ... ... | 5 | ... | ... | ... | 2¾— 3½ | 3 — 3½ | ... | ... |
| 79,900 | Westminster Electric Supply, Ord., 101 to 80,000 ... | 5 | 7 % | 9 % | 12 % | 15½— 16½ | 15½— 16½ | 16½ | 15⅝ |

* Subject to Founder's Shares. † Quotations on Liverpool Stock Exchange.

‡ Unless otherwise stated all shares are fully paid. § Dividends paid in deferred share warrants, profits being used as capita

Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

## SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

### ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

| Present Issue. | NAME. | Stock or Share. ‡ | Dividends for the last three years. 1895. | 1896. | 1897. | Closing Quotation July 20th. | Closing Quotation July 27th. | Business done during week ended July 27th, § Highest. | Lowest. |
|---|---|---|---|---|---|---|---|---|---|
| 30,000 | British Electric Traction ... ... ... ... ... | 10 | ... | ... | ... | 16½— 17 | 16½— 17 | 16⅝ | ... |
| 10,000 | Do. do. 6 % Cum. Pref. 30,001—40,000 £7 pd. (issued at £2 10s. prem. all pd.) | 10 | ... | ... | ... | 10½— 11 | 10½— 11 | ... | ... |
| 90,000 | Brush Elecl. Enging., Ord., 1 to 90,000 ... ... ... | 3 | 2½% | *nil* | *nil* | 1⅞— 2⅛ | 1⅞— 2⅛ | 1⅞ | ... |
| 90,000 | Do. do. Non-cum. 6 % Pref., 1 to 90,000 | 2 | 3 % | *nil* | 4 % | 2⅛— 2⅜ | 2⅛— 2⅜ | 2⅜ | 2⅛ |
| 125,000*l* | Do. do. 4½ % Perp. Deb. Stock ... | Stock | ... | ... | ... | 110 —114 | 110 —114 | ... | ... |
| 50,000 | Do. do. 4½ % 2nd Deb. Stock Red. ... | Stock | ... | ... | ... | 102—105 | 102 —105 | 103¼ | ... |
| 19,894 | Central London Railway, Ord. Shares ... ... ... | 10 | ... | ... | ... | 9⅝— 10¼ | 9⅝— 10¼ | 10¼ | 10⅛ |
| 129,179 | Do. do. do. £6 paid ... ... | 10 | ... | ... | ... | 5¾— 6¼ | 5¾— 6¼ | 6 | ... |
| 59,254 | Do. do. Pref. half-shares £1 paid ... | ... | ... | ... | ... | 1¼— 1⅜ | 1¼— 1⅜ | ... | ... |
| 67,680 | Do. do. Def. do. £5 paid ... | ... | ... | ... | ... | 4¼— 4⅝ | 4¼— 4⅝ | ... | ... |
| 630,000*l* | City and South London Railway ... ... ... ... | Stock | 1 5/16 % | 1 9/16 % | 1⅞% | 68 — 71 | 68 — 71 | 70¾ | 70 |
| 22,500 | Do. do. Ord. shares, Nos. 1 to 22,500 £3 pd. | 10 | ... | ... | ... | 2¾— 3¼ | 2¾— 3¼ | ... | ... |
| 32,098 | Crompton & Co., Nos. 1 to 32,098 ... ... ... ... | 3 | ... | ... | ... | 1⅝— 2¼ | 1⅝— 2¼ | ... | ... |
| 82,850 | Do. 5% 1st Mort. Reg. Debs., 1 to 743 of £100, and 901 to 1,070 of £50 Red. | ... | ... | ... | ... | 89 — 94 | 89 — 94 | ... | ... |
| 99,261 | Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261 | 5 | 5 % | 5½% | 6 % | 2¼— 2⅜ | 2¼— 2⅜ | ... | ... |
| 17,139 | Do. do. do. "A" Shares, 01—017,139 | 5 | 5 % | 5½% | 6 % | 4 — 5 | 4 — 5 | ... | ... |
| 194,023 | Do. do. do. 4 % Deb. Stock Red. ... | 100 | ... | ... | ... | 101 —103 | 101 —103 | 102¾ | ... |
| 110,000 | Electric Construction, 1 to 110,000 ... ... ... ... | 2 | 5 % | 6 % | 6 % | 2¼— 2⅜ | 2¼— 2⅜ | ... | ... |
| 16,343 | Do. do. 7 % Cum. Pref., 1 to 16,343 ... | 2 | 7 % | 7 % | 7 % | 3⅛— 3⅜ | 3⅛— 3⅜ | 3¼ | ... |
| 111,100 | Do. do. 4% Perp. 1st Mort. Deb. Stock ... | Stock | ... | ... | ... | 105 —107xd | 105 —107 | ... | ... |
| 91,196 | Elmore's Patent Copper Depositing, 1 to 70,000 ... ... | 2 | ... | ... | ... | ⅜— ⅝ | ⅜— ⅝ | ... | ... |
| 67,275 | Elmore's Wire Manufacturing, 1 to 69,385, issued at 1 pm. | 2 | ... | ... | ... | ¼— ½ | ¼— ½ | ... | ... |
| 9,600*l* | Greenwood & Batley, 7 % Cum. Pref., 1 to 9,600 ... | 10 | 10½% | 7 % | 7 % | 8 — 10 | 9 — 11 | ... | ... |
| 12,500 | Henley's (W. T.) Telegraph Works, Ord. ... ... ... | 10 | 8 % | 10 % | 12 % | 21⅜— 22½ | 21⅜— 22½ | 22 | 21½ |
| 3,000 | Do. do. do. 7 % Pref. ... ... | 10 | 7 % | 7 % | 7 % | 18½— 19½ | 18½— 19½ | ... | ... |
| 50,000 | Do. do. do. 4½ Mort. Deb. Stock... | Stock | 4½% | 4½% | 4½% | 110 —115 | 110 —115 | ... | ... |
| 50,000 | India-Rubber, Gutta-Percha and Telegraph Works ... | 10 | 10 % | 10 % | 10 % | 21⅜— 22½xd | 21⅜— 22½ | 22⅛ | 22 |
| 300,000 | Do. do. do. 4 % 1st Mort. Debs. | 100 | ... | ... | ... | 102 —106 | 102 —106 | 105 | ... |
| 37,500 | †Liverpool Overhead Railway, Ord. ... ... ... ... | 10 | 2⅞% | 2⅞% | 3¼% | 10⅜— 10½ | 10 5/16— 10 7/16 | ... | ... |
| 10,000 | † Do. do. Pref., £10 paid ... ... | 10 | 5 % | 5 % | 5 % | 15¾— 16¼ | 15¾— 16¼ | ... | ... |
| 37,350 | Telegraph Construction and Maintenance ... ... ... | 12 | 15 % | 15 % | 15 % | 36 — 39 | 36 — 39 | 39 | ... |
| 150,000 | Do. do. do. 5 % Bonds, red. 1899 | 100 | 5 % | 5 % | 5 % | 100 —103xd | 100 —103 | ... | ... |
| 540,000*l* | Waterloo and City Railway, Ord. Stock ... ... ... | 100 | ... | ... | ... | 116 —121 | 116 —121 | 118 | 117 |

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid.

Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

### LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

*Birmingham Electric Supply, Ordinary £5 (fully paid) 10⅛xd.
House-to-House, 4½% Debentures of £100, 106—109.
Kensington and Knightsbridge Electric Lighting, Ordinary Shares £5 (fully paid) 12—14; 1st Preference Cumulative 6%, £5 (fully paid), 8—8½. Debentures, 106—108. Dividend, 1897, on Ordinary Shares 10%.
London Electric Supply Corporation, £5 Ordinary, 3½—4.
*T. Parker, £10 (fully paid), 14½xd.
Yorkshire House-to-House Electricity, £5 Ordinary Shares fully paid, 8¼—8⅝. Dividend for 1896—6%.

* From Birmingham Share List.

Bank rate of discount 2½ per cent. (June 30th, 1898).

## THE MUNICIPAL ELECTRICAL ASSOCIATION, 1898.

### THE USE OF ACCUMULATORS IN CONNECTION WITH LIGHTING AND TRACTION SYSTEMS.

By JOHN H. RIDER, Borough Electrical Engineer, Plymouth.

(*Concluded from page* 138.)

In the first place the accumulators would take the peaks of the load, thus relieving the machinery of the sudden jerks due to starting the cars, and in the second place the amount of running plant could be reduced to that sufficient for the average load. Fig. 5 will serve to illustrate this.

The curves were taken from an actual tramway system, having eight cars running, and are self-explanatory. It will be seen that the pressure varies from about 495 to 510 volts, the current taken by the cars from 300 to 375 amperes, and the dynamo output (shown by the thick line A—B) from about 115 to 150 amperes. All the output above that of the dynamo is supplied by the discharge of the accumulators, and the hollows below the output are filled up by a charge.

Without the accumulators, sufficient machinery would have had to be kept running to supply the maximum load of 375 amperes, although the average load was not greater than about 150 amperes. As it is, one dynamo will easily do the work instead of two, and can be kept at a very regular load throughout the whole time. So regular, in fact, that lighting could easily be done from the same machine.

The cells in this case were connected as a whole directly to the bus bars, in parallel with the dynamo, no regulating switches being used

In order that the accumulators shall take their share of the load in this manner, it is necessary that they should be of ample size for the work, with a low internal resistance, and that the dynamos should be shunt-wound with a falling characteristic. When it is required to fully charge the cells, a booster is generally used.

In order to assist the battery to discharge when the total load exceeds the output of the dynamos, and to charge when the load is less, a compound-wound booster is sometimes used, in the manner indicated in fig. 6.

The booster, which in the figure is shown motor driven, has two field windings in opposition to one another. When the line current is equal to the output of the dynamos, the two windings must neutralise each other, and the booster will give no pressure. Then the battery will neither charge nor discharge. When the line current is less than the output of the dynamos, the shunt winding will predominate, and the booster pressure will be in the right direction for charging the cells. When the line current is greater than the output of the dynamos, the series winding will change the polarity of the booster, so that it will add a pressure to the battery circuit, and thus help it to discharge. By means of the switch S, the battery can be connected directly to the line when required.

Prof. Mengarini, of Rome, uses automatic switches to vary the number of cells in the accumulator circuit, so that with a fixed machine voltage, the battery may be charged and discharged at such rates, as to maintain a constant output for the machines. At Leeds, also, automatic switches are used for the same purpose, worked by means of a relay and small motor. The great complication, however, introduced by the use of automatic switches, and the evils attendant upon the irregular charging of the end cells, are strong arguments against their use.

Fig. 5 also shows that if the battery be large enough for its work, and the dynamos shunt wound with a sufficiently drooping characteristic, it will not be necessary to use either a compound wound booster or regulating switches, in order to keep a steady load on the dynamos. It would be very interesting to know whether the automatic switches give any trouble at Leeds, and whether they are still used.

Besides being used in the generating station, accumulators can be of great service in sub-stations, at the far end of long traction systems, for the purpose of keeping up the line pressure. They can be either charged by means of a special feeder from the generating station, or directly from the line during periods of light load, with the help of a booster.

A system of some interest is the combination of cells carried upon the cars, with the use of the overhead conductor, as at Hanover. In those parts of the town where the trolley wire is not permitted, the cars are run directly from the cells carried by them, while outside the town the ordinary trolley system is in use. The cells can be charged

in position from the trolley wire, or at the station in the ordinary way.

Accumulators used in the generating station, or in sub-stations, should be mainly charged during the time the cars are not running, say, from midnight to 6 a.m. During the remainder of the day they would be in parallel with the generating plant, to be used as required.

### COMBINED LIGHTING AND TRACTION STATION.

The addition of a lighting load to the ordinary traction station may not be of much benefit to the latter, but the combination of a tramway and lighting load will be of great service to the lighting station. Attention was drawn to the many advantages to be gained by the lighting station from this combination in a paper presented

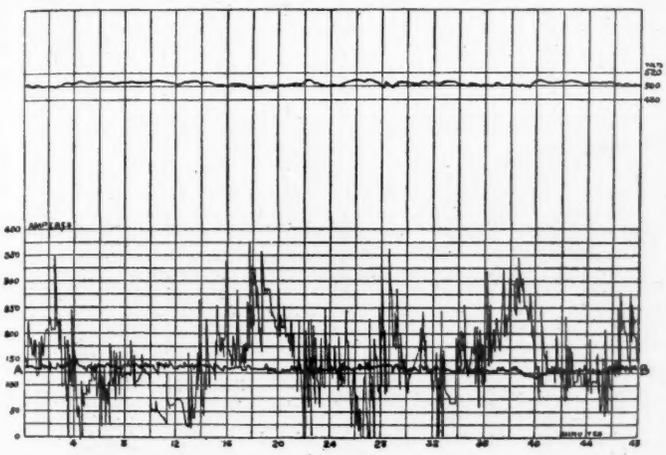

FIG. 5.

to this Association at its 1898 Convention, of which the writer was joint author, and a number of the practical points were considered in a contribution by the writer to *Lightning* in November of the same year. It will not be necessary therefore to deal more than briefly with the subject at the present time.

In arranging a combined lighting and traction station, the one aim of the engineer should be to use as much of the plant as possible for the combined purpose. The boilers and steam piping would be common in any case, and the engines (at any rate during the daytime) could be used to drive the lighting and traction machines at the same time. The exact method of arranging the plant would depend upon the local conditions; but by adopting sets similar to fig. 4, one machine for traction, and the other for lighting, the combined load

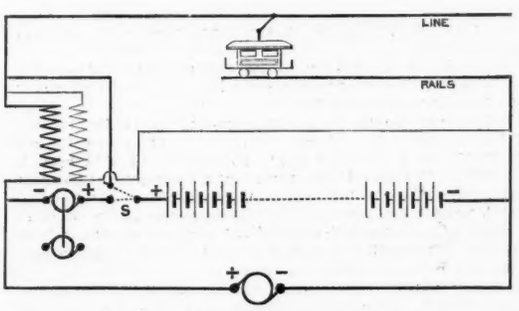


FIG. 6.

could be taken by the same engines. A battery of accumulators properly arranged would prevent the fluctuations of the tramway load from affecting the lighting. During the evening both machines could be used for lighting if desired, leaving the accumulators to deal with the traction. After midnight the battery would be charged.

With a proper relation between the tramway load and the lighting load, it should be possible to have a nearly constant output for the boilers and engines throughout the 24 hours. The accumulators would look after the fluctuations in the day time, and take the overlapping of the loads during the evening.

Before closing, the writer would like to draw attention to, and protest against, what seems to be a common practice amongst accumulator manufacturers. When maintenance rates are asked for and received, it will generally be found that, unless the capacity has been specified by the customer, the contractor will have offered to maintain the battery to not more than from 60 per cent. to 70 per cent. of its original capacity. When a battery is put in to do certain work, it ought to be understood that its full capacity would always be required. But from the fact that most contractors will not offer to maintain 100 per cent. capacity without excessive terms, it would appear that batteries, as a rule, are rated too high in their lists.

## AUSTRALIAN ELECTRICAL NEWS.

[FROM OUR SYDNEY CORRESPONDENT.]

CONSIDERABLE attention has been devoted lately to the lighting of the city of Sydney by electricity, and the circumstance has been recalled that a conference on this subject took place between the Railway Commissioners and representatives of the City Council on February 2nd of last year. This conference was held on the initiative of the City Council and in accordance with the terms of a resolution passed some weeks previously. The resolution contemplated that the subject should be discussed from two standpoints. The Council was desirous of ascertaining, in the first place, whether, in the event of it building and equipping a power house for the purposes of lighting the city by electricity, the Railway Commissioners would require to obtain from the Council the necessary power for the electric tramway they were about to construct. The second object of the conference was for the Council to ascertain whether any scheme carried out by the Railway Commissioners in connection with the electric tramway would be of such a nature as to permit of the Council obtaining from the Commissioners the power for lighting the city as well as the supply of electricity for private purposes through the medium of the Council. It was pointed out at the conference that the Commissioners were about to establish a plant that would not only meet all their requirements in connection with the running of the George Street electric tramway, but that whilst making such provision they would of necessity have regard to the requirements of the whole metropolis when the existing tramlines had been converted so as to be driven by electricity.

It was also recognised that whatever the scale of magnitude that might be adopted, the Commissioners would always have a certain surplus of power which would be available for use for purposes outside of the tramways altogether. It was stated that the arrangements which were to be carried out at Altimo were designed to meet all probable requirements for the next 10 years at least. Arrangements had been made to provide the equivalent of 14,000 horse-power, whereas for the present only 4,000 horse-power would be needed. Both the parties to the conference admitted that one electric plant would meet all the requirements, not only of the Commissioners, but also of the City Council for some time to come at least, and that by the employment of one plant instead of two independent ones with independent structures and separate staffs, there would be a great saving in capital expenditure and cost of maintenance. It was ascertained from the Commissioners, that while the plant that was provided for the tramways would be required mostly in the daytime for generating the power necessary for the efficient working of the tramways, it would be available during a portion of the evening and throughout the night for generating power that could be utilised in connection with commercial purposes and the lighting of the city. The idea of relying on the Commissioners for supplying whatever electricity might be required by the Council, was regarded with favour by the Council's representatives, and it was suggested that, as a tentative measure, if the Council and Commissioners could agree upon terms, the Council would make a start with the power for 431 arc lamps and 443 incandescent lamps of 50 C.P. for the street lighting. A suggestion was made, that before any definite arrangement was entered into between the Council and the Commissioners, it might be necessary to obtain legislative sanction for doing what was contemplated. A recommendation was made by the Commissioners that an expert should be appointed by the Council to advise the Commissioners and give advice generally to the Council on the matter. Since the conference was held the electrical engineer for the tramways has considered the whole subject, and he has pronounced the scheme a perfectly practicable one.

Nothing has been done on either side since the conference with a view to advancing the question. On the one hand the Commissioners appear to be awaiting some communication from the Council, and on the other hand, the representatives of the Council have been looking for some minute embodying the conditions on which the Commissioners would enter into the proposed contract with the Council. In the meantime the Commissioners have agreed to supply power to the water and sewerage board, and also to a private consumer on the tram route, who will take power at the rate of about 75 kilowatts; and the City Council have decided to light the new markets by incandescent gas.

The construction work of the George Street tram is being pushed on rapidly, George Street and Harris Street being up in several places for the laying of the track and erection of poles for the overhead work; the power house at Altimo is showing good progress, and news has been received that the first of the big General Electric generators has been shipped and is on its way.

Another extension of the electric tram service at North Sydney has been opened to Willoughby. The new line commences at the terminus of the cable tramway in Falcon Street. It is 2 miles 45 chains long, the steepest gradient is 1 in 14, and the sharpest curve 66 feet radius. The rails are 60 lbs. to the yard, and are laid on ironbark sleepers and sandstone ballast, and are bonded with the Edison-Brown plastic bond. The new generator is of 100 kilowatt capacity and General Electric Company's manufacture, and is located at the Ridge Street cable power house. In addition to this, an accumulator house has been provided near the other end, with a booster and chloride battery as a feeder station. The overhead wires are mostly carried on side brackets. Two G.E. 800 motors are used

on each car. The cost is about £17,000, the contractors being A. Johnson, for permanent way; Noyes Bros., bonding; Eaton Bros., poles and brackets; H. H. Kingsbury, generators and motors; Gibson, Battle & Co., storage batteries; and Edge & Edge, overhead wiring, boosters, and switchboard.

The municipal authorities of Newcastle have resolved to carry out Mr. Norman Selfe's scheme for the improvement of the electric lighting system, at a total cost of £5,500. Of this amount £2,300 is to be expended in the erection of a new station, and £3,200 in the purchase of a new plant of 60 kilowatts capacity, and new underground mains. The Goulburn City Council are calling for tenders for a loan of £10,000 to enable them to carry out their electric lighting scheme.

An English syndicate is said to be negotiating for the purchase of the Ballarat (Vic.) Electric Supply Company's property, and the extension of the lighting throughout the city. It offers the present company £4,000 for the plant, which cost twice that amount, and is prepared to expend upwards of £20,000 in laying underground wires, and effecting general improvements to the service. A sum of £1,000 has been deposited in a Melbourne bank as a proof of *bonâ fides*, and the municipal authorities are being asked for an extension of lease, and for their sanction otherwise to the proposals. The Ballarat Gas Company are putting forward rival claims, and desire to secure the authority of the Governor-in-Council under the Act to a scheme for lighting the city of Ballarat, town of Ballarat East, and borough of Sebastopol, with electricity

## FALK CAST WELDED RAIL JOINTS.

[COMMUNICATED.]

The essential difference between tramway and railway track work is, that the rails for a tramway, when once laid, are covered in up to the tread of the rail by paving of some sort. Therefore, when the track is once laid, unless special devices are adopted, it is impossible to get at the fish plates, and the bolts holding the fish plates in position become loose, in time, as they are not subjected to inspection. It has been the experience on all the tramways in this country on which mechanical power has been used, that after a very few years the joints begin to give trouble. It is evident that when heavy motor cars pass over a joint, unless the joint is absolutely solid, there will be a tendency on the part of the rails to separate while the wheel is passing from one rail on to the other. This causes what is known as the "hammer blow," which is injurious to the motors on the car and bad for the track. It causes the head of the rail to wear down at joints, thus increasing the tendency to hammer. The hammering also causes the concrete, on which rails are generally laid in this country, to wear away, and water filtering through the pavement increases this difficulty.

It is evident that from the tramway manager's point of view the best possible track would be a continuous one, without any joints whatsoever. For many years past, but especially since electric traction was introduced, inventors have been hard at work seeking means whereby this could be practically attained. The first idea naturally was to electrically weld the rails, and the Johnson Company of the United States spent a great deal of time and money in trying to perfect a system of electrically welding the track. As far as the operation itself went, it was perfectly successful. There was only one great drawback, namely, the very large cost of the plant required to do the work, and the necessity of having highly skilled labour. The price of joints was, therefore, excessive, and inventors endeavoured to discover another system. The Falk Manufacturing Company finally succeeded in practically solving this problem, and since 1894 a very large mileage of track in the United States has been laid on their system, and the results obtained have been excellent.

There is still a great prejudice against the continuous rail, the chief reason for this being that standard *railway* practice makes special allowances for contraction and expansion at joints. It was thought that if a continuous track were laid, and the paving on the length of road removed, the track would buckle or rise up; but experience has proved that this is not the case. It was feared that with a continuous rail the paving might be damaged and torn, owing to contraction and expansion of the rails, but as regards this point experience has now demonstrated that a continuous track is superior to an ordinary one,

Fig. 1.

as the joints are all held so firmly that the rails are practically immovable, and differences of temperature will simply change the molecular condition of the rail and the stresses in the rail. In tramway work, it must furthermore be borne in mind that variations of temperature do not affect the rails as much as one might think, owing to their being entirely covered in by pavement of some kind which is a non-conductor of heat.

It is easy to ascertain the strain on the rails due to the variations of temperature. Assuming a coefficient of expansion for steel of 0·0000065, and multiplying this by 75, which is a liberal figure for the number of degrees of maximum deviation from the temperature at which the welding is done, we get 0·000487, which is that part of its length which a rail would expand when exposed to a rise of 75°—or contract when exposed to a fall of 75° in temperature. A steel bar will expand 0·00003 of its length, due to a load of 1,000 lbs. per square inch. Dividing the estimated expansion by this figure, we get for the strain 16,200 lbs. per square inch. As 40,000 lbs. per square inch is a safe value for the elastic limit of steel, it can readily be seen that the elastic limit will never be reached; and this means that these expansions and contractions may go on indefinitely, and as long as the joints remain unbroken, no harm will be done to the rail, for stresses within the elastic limit work no harm.

Assuming 80,000 lbs. per square inch as the ultimate strength of steel, we see that, so far as the strength of the rails themselves is concerned, we have a factor of safety of five.

Wherever joints have broken, in no case have they pulled apart more than 2 inches. This would seem to show that the pull which broke the joint was not a cumulative effort extending all along the line, but merely the result of a local strain extending but a short distance on either side of the joint.

The Falk system is now being introduced in Great Britain for the first time by Mr. Robert W. Blackwell, at Coventry and at Norwich, where some 5,000 joints are now being cast welded. The system roughly consists in casting a cast-iron sleeve round the sides and bottom of the rail joints, the rail ends being first placed firmly together. In cases where they do not absolutely touch, thin plates of steel are driven in between the heads of the rails before casting. Before fixing the moulds, which are of cast-iron, the sides and bottom of the rail are cleaned, and this is generally done with an emery wheel or a sand blast. The cast-iron used is of special chemical composition to give good results, and is run at a much greater heat than

is used in making ordinary castings. The cast-iron running into the iron moulds cools rapidly on the outside surface, thus causing a tremendous pressure to be exerted on the metal which is still in its molten state in contact with the web and foot of the rail. As the metal is poured in from one side and comes in contact with the web or thinnest part of the rail at its greatest heat, this part of the rail is brought to a white heat, and owing to the tremendous pressure exerted on the molten cast-iron, this is practically forced into the interstices of the steel, thus not only making a thoroughly good mechanical joint, but also ensuring a good electrical joint.

The section of the cast-iron joint is so designed as to have at least the same tensile strength as that possessed by the rail. The cast welded joints used are generally about 14 inches long, and the weight of cast-iron varies in accordance with the weight of the rail, from 70 to 140 lbs. per joint.

The cast-iron must necessarily be melted close to where the work is being done, and for this purpose a cupola on wheels is necessary. The apparatus consists of a small cupola with the necessary fan, steam turbine and boiler fitted on to a truck to be drawn by horses. In the apparatus used at Norwich, gearing is fixed to the wheels, so that the steam engine which drives the fan is utilised as motive power to propel the car.

Fig. 1 shows the first two cast joints ever made in England, the one on the left hand side of the picture having had the moulds removed. The right hand side shows a joint with the moulds and clamps still in position.

Fig. 2, which represents the first joint after it has been sawn in half, shows the thorough contact which exists between the cast-iron and the steel of the rail.

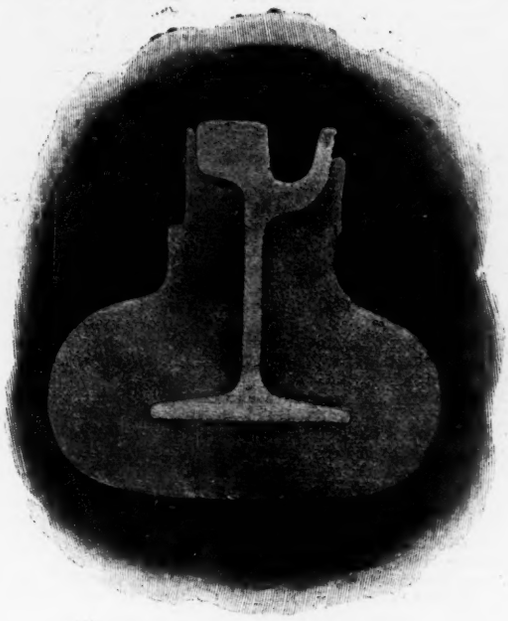

Fig. 2.

The enterprise of the Coventry and Norwich Tramways in adopting this as yet untried system in England, is to be commended, and from the portion of the work which has been already finished, there is no doubt that it will be highly successful. The progress of this new system will undoubtedly be closely watched by all interested in tramway construction.

Engineers unacquainted with the good results that have been obtained by cast welding, have expressed the fear that as it would be impossible for the cast-iron to be welded to the steel of the rail, water would get in and cause rust, which would destroy the conductivity of the joint, and diminish its mechanical strength to such an extent as to cause rupture. Further doubts have been expressed, that the great heat of the molton cast-iron would anneal the steel rails, rendering these softer at the joints and liable to wear. In answer, it may be stated, as one example among many, that in 10 miles of track which were cast welded at St. Louis in the early part of 1894, and over which there has been a very heavy traffic, the joints to-day are in as good condition as when they were first made, and so perfect that it is practically impossible to detect them.

At the present moment there are some 200,000 cast joints in the United States. A large amount of such work has also been done in France and Germany.

## THE FULMEN ACCUMULATORS (TOMMASI SYSTEM) AT THE EXHIBITION OF AUTOMOBILES.

[COMMUNICATED.]

These accumulators, the remarkable qualities of which have long been known, attracted special attention on the occasion of the cab competition.

The various systems of electric carriages that took part successfully in this competition were worked by the Fulmen accumulator.

This accumulator, by virtue of its lightness and power, is, in fact, at present the only one that enables daily journeys of 50 to 60 kilometres to be performed without changing.

We know that the most important and the most delicate part of an electro-mobile is the accumulator, therefore, as M. Hospitalier rightly remarks, the present competition is a genuine triumph for the Fulmen accumulator (Tommasi system).

The type of element used specially for electric carriages weighs, including the liquid, 7·5 kg. It gives normally an output of 40 available watts and has an available energy equal to 200 watt-hours. We may consider as the normal *régime* of discharge a current of 21 amperes corresponding to a continuous discharge of five hours, or a density of current of 1 ampere per square decimetre of surface of positive electrode, but the accumulator can, at the expense of its capacity, supply as much as 50 amperes in continuous discharge and as much as 100 amperes in an interrupted discharge, a sudden strain, for instance. At the normal discharge in five hours, the mean available difference of potential of the element is 1·9 volt, and the capacity 105 ampere-hours. The specific constants of the element, as determined by M. Hospitalier are as follows, compared with the total weight:—

| | |
|---|---|
| Specific output in amperes per kg. ... ... ... | 5 |
| Available specific power in watts per kg. ... ... ... | 5·5 |
| Specific capacity, in ampere-hours per kg. ... ... | 146 |
| Available specific energy in watt-hours per kg. ... ... | 26 |
| Specific weight in kg. per kilowatt... ... ... ... | 190 |
| Specific weight in kg. per kilowatt-hour ... ... ... | 37·5 |

At the *régime* of 5 watts per kg. the Fulmen accumulator contains therefore more than 25 watt-hours per kg.

These figures, M. Hospitalier observes, represent the maximum of what can be obtained from the present accumulators.

The weight of accumulators carried by each carriage was from 350 to 550 kilogrammes, *i.e.*, it varied between one-third and one-fourth of the total weight of the carriage. Notwithstanding this comparatively small proportion, the energy stored up was sufficient to enable the carriages to accomplish journeys of 90, 100, and 105 kilometres, as was proved on the last day of the competition, on which occasion the track included the hills of Sacré-Cœur and Montsouris. We append the following details:—

| | |
|---|---|
| Weight of the vehicle including five passengers ... | 1,300 kg. |
| „ of the accumulators ... ... ... ... | 450 „ |
| Speed per hour on level ground... ... ... ... | 20 km. |
| „ „ „ on ascents of 12 per cent. ... ... | 6 „ |

We may add that the expenditure for each carriage, including maintenance and getting the battery into working order, did not exceed a mean of 6 *frs.* per day.

In short, therefore, the Fulmen accumulator (Tommasi system) is believed to constitute the long sought-for solution of the problem of the electric carriage, and it is also considered that the problem of cheap electric traction is now practically solved.

## THE CHEMISTRY OF HIGH TEMPERATURES.

The following is a copy reproduced from the *Franklin Institute Journal* for July, of the report of the Franklin Institute, through its Committee on Science and the Arts, on the investigations of M. Henri Moissan, with the electric furnace:—

The Franklin Institute of the State of Pennsylvania for the Promotion of the Mechanic Arts, acting through its Committee on Science and the Arts, investigating the merits of Moissan's investigations with the electric furnace, reports as follows:—

The researches conducted by M. Henri Moissan, with the aid of his electrical furnaces, extend over a period of about five years, and have won for this distinguished chemist an additional title to take rank with the foremost exponents of scientific inquiry at the close of this century of science, so auspiciously inaugurated by the great discoveries of Gay Lussac and Sir Humphry Davy.

In preparing a report upon the work of the French chemist, your committee feels that it might well be content to pass in review those brilliant discoveries which have become universally known, and that it would scarcely be possible to refer to all the valuable and interesting results without making the report too voluminous.

At the same time, the committee believes that much of M. Moissan's purely scientific work has not been as generally recognised as it deserves to be, and, therefore, begs to present the following statement:—

The application of the high temperatures attainable by means of the electric arc for the purpose of producing physical and chemical effects is by no means of recent date. Many important observations on the effects of electric heat were made already by Van Marum at the close of the last century, and by Humphry Davy, the discoverer of the arc, at the beginning of the present one. In 1849 Despretz utilised the intense heat of the arc in various scientific investigations, and later Pichon, Siemens and Huntingdon, Cowles, Heroult, Grabau, Borchers, Acheson, Willson and many others either suggested or realised the employment of the electric furnace for various industrial purposes.

In all these cases, however, the materials subjected to the arc were directly exposed to and permeated by it. But, while this may not be objectionable in many industrial processes, the presence in the arc

of vapours of carbon and other substances emanating from the electrodes, and the attendant electrolytic action, constitute a set of disturbing influences which will generally complicate the results, and render them liable to lead to erroneous conclusions.

Guided by these considerations, M. Moissan endeavoured to devise a furnace which would subject bodies to the highest temperatures of the electric arc under simple and controllable conditions. He has constructed five modifications of such a furnace, which are characterised by the following features:—

1. A furnace consisting of a block of lime, hollowed out, and provided with electrodes in such a manner as to maintain the arc above the substance. The cavity is lined with suitable materials.

2. A furnace of fine-grained limestone lined with alternate layers of carbon and magnesia, the former on the inside. This construction permits the use of higher temperatures than the preceding one, and is well adapted for receiving crucibles.

3. A furnace provided with a tube of refractory material, passing horizontally through the cavity. This arrangement affords a heated space, which is accessible from without, and protected from the action of any gases existing within the furnace. When desired, currents of gases or vapours can be passed through the tube while it is being heated.

4. A furnace in which the tube is given an inclined position, which permits a continuous operation; the charge is introduced at the upper mouth, while the products are removed or flow from the lower one.

This model was employed for preparing large quantities of pure products in a short time.

5. A furnace with a larger number of electrodes and arcs.

By this means a considerable space can be evenly heated, and large amounts of material treated in one operation.

By thus excluding electrolytic action, M. Moissan was enabled to investigate the simple heating effect of the current. The temperature ranged from 2,005° to beyond 3,800° C. While it is not possible to give exact figures for the highest temperature attained, an idea of the conditions may be formed from the description of some of the experiments. The currents employed varied from 35 amperes at 55 volts to about 1,600 amperes at 110 volts.

The results obtained by means of the electric furnace may be considered comprehensively under the following heads:—

I.—*A series of researches on the fusion and volatilisation of refractory bodies.*

Various compounds and elements which are either infusible or non-volatile at the highest temperatures attainable by combustion were melted or vaporised when subjected in the furnace, Model 1, to an arc consuming 30 to 40 horse-power of energy.

Thus lime, magnesia, molybdenum, tungsten, vanadium and zirconium were readily fused, and lime, silica, copper, platinum, aluminium, boron, carbon, and other refractory bodies volatilised.

Many of these bodies were obtained, either by fusion or sublimation, in a crystallised form.

By heating mixtures of several oxides a series of new double oxides was prepared.

II.—*In a second series of experiments a number of reactions, which can be effected at the highest temperatures only, were made the subject of investigation.*

The carbonates of barium and strontium were, without difficulty, resolved into carbonic acid and the oxides. Those oxides, which had withstood the de-oxidising action of carbon at the highest temperature of ordinary furnaces were readily reduced by that element in the electric furnace; others, whose reduction by carbon in the wind furnace is difficult or incomplete, readily yielded their oxygen to the carbon under the action of the arc.

It was thus possible to obtain aluminium, silicon, the alkaline-earth metals, uranium, vanadium and zirconium. Moreover, manganese, chromium, tungsten, and molybdenum were produced in the reguline state and in considerable quantities. Certain ingenious precautions were observed to prevent the metals named from combining with oxygen, nitrogen, and carbon, and to remove the last-named element after a carbide had been formed.

As many of these products were for the first time obtained in the pure state, or in much larger quantities than before, a careful study of their properties afforded innumerable new and interesting observations, and led to the revision of many statements published by former investigators.

The study of chromium and vanadium proved especially interesting. Titanium was found to be converted into the nitride when subjected to an arc produced by a current of 400 amperes and 60 volts, but to remain metallic when a current of 1,200 amperes and 70 volts was employed.

Reductions were also effected by substituting metallic reducing agents for the carbon, and interesting new alloys were thus prepared.

III.—*The study of the three allotropic modifications of carbon constituted a third extended series of experiments.*

It is impossible here to do more than mention a few of the more important results.

The most important, perhaps, and the one which has become universally known is, that ordinary charcoal may, by means of the electrical furnace, be converted into diamond.

When molten iron at 3,500° is saturated with carbon and the mass then suddenly chilled on the outside, the enormous pressure produced in the interior will cause part of the carbon which separates to crystallise in the form of diamond. Both the transparent and the black (carbonado) varieties were thus obtained—the former in octahedra and cubes, as well as in fragments; the specific gravity of 3·5, the hardness and all characteristics corresponded to those of the native stone.

It is further shown that, at about 3,000°, under ordinary pressure all the modifications of carbon are converted into graphite, and various varieties of this (the ultimately stable form of carbon) were recognised and studied.

The reason for the infusibility of carbon under ordinary pressures was established to be due to the fact that it passes directly from the solid into the gaseous condition. Carbon was actually sublimed and the reactions of its vapour studied.

IV.—*There yet remains to consider the investigation of several new series of crystallised compounds belonging to the classes of borides, silicides, and carbides.*

M. Moissan has shown that these compounds, as a rule, have very simple compositions, and that, at the highest attainable temperatures, carbon, silicon, and boron generally form but one compound with another element.

The silicides, like Acheson's carborundum, possess extraordinary hardness; some, as those of boron and titanium, appear to be even harder than the diamond.

Of the metals, some do not combine with carbon; others while dissolving it at very high temperatures deposit it as graphite before they solidify. A very large number of metals, however, form definite, crystallised carbides.

These M. Moissan divides in two classes; those which decompose water at ordinary temperatures, as, for example, the carbides of the metals of the alkalies and alkaline earths, of aluminium, cerium, &c.; and those which do not react in this manner, and which include the carbides of chromium and titanium.

It appears that M. Moissan was the first to produce the crystallised calcium carbide in the electric furnace. He has also exhaustively studied the action of the various carbides on water. In a few cases, as with calcium carbide, there resulted a single hydrocarbon in a pure state; in others, mixtures of hydrogen with one or several hydrocarbons, such as methane, ethylene, and acetylene. The most interesting carbides in this respect, however, are those of cerium and uranium. They were found to yield not only gaseous hydrocarbons but considerable quantities of liquid and solid hydrocarbons.

M. Moissan believes that analogous reactions play an important *rôle* in the formation of natural gas, petroleum, and other natural hydrocarbons; he has advanced a new and interesting theory in regard to this.

The above is but a meagre *résumé* of the work done by M. Moissan with his electric furnace. The enormous number of new and valuable results obtained by him necessitated a selection. In studying the effects of extreme temperatures the French chemist has opened up a new and extended field to scientific research, and the harvest already reaped from it has greatly enriched our stores of knowledge in the provinces of chemistry, physics, and geology. Innumerable practical applications suggest themselves, and not a few have already been realised.

As a conclusion, we wish further to state that the manner in which he has described, interpreted and summarised his experiments and his results cannot fail to incite others to follow the paths he has prepared, and lead them to further discoveries in this field.

In view of these facts, your committee takes pleasure in stating that the highest award the Franklin Institute can bestow, could not find a worthier recipient than the author of these researches.

The Franklin Institute, therefore, awards the Elliott Cresson Medal to M. Henri Moissan, of Paris, France, for his work on the chemistry of high temperatures.

Adopted at the stated meeting of the Committee on Science and the Arts, held Wednesday, December 1st, 1897.

JOHN BIRKINBINE, *President.*
WM. H. WAHL, *Secretary.*

Countersigned by
JAMES CHRISTIE,
*Chairman of the Committee on Science and the Arts.*

Philadelphia, *November 1st*, 1897.

## THE TELEPHONE INQUIRY.

(*Continued from page* 142.)

THE Select Committee on the telephone service resumed its sitting on Thursday, July 21st, Mr. Hanbury presiding.

Sir COURTENAY BOYLE, secretary to the Board of Trade, was the first witness, and gave evidence chiefly in relation to the working of the provisional order system, under the Electric Lighting Acts of 1882 and 1888, under which powers are granted to private companies and municipalities to undertake the supply of electricity.

Replying to the CHAIRMAN, Sir COURTENAY said that a great many municipalities were now working the electric light within their own area, and the number was increasing. In only three cases had the Board of Trade granted provisional orders to local authorities to go outside their own districts. If a municipality wished to work the electric light within its own area it got special borrowing powers for the purpose under the Electric Lighting Act of 1882. When an application was made to the Board of Trade for a license, either by a company or a municipality, the Department heard objections, if there were any. In the case of a municipality, sometimes the ratepayers objected to the speculation, and sometimes there was another lighting authority, in which, sometimes, one section of the cor-

poration was interested. The municipality, as a general rule, was the road authority, and it had, therefore, full control over the streets for the purpose of laying electric wires. He did not see any objection to giving municipalities powers to supply a telephone under provisional orders, just as they supplied electric light. The procedure was very simple, and the cost very slight.

Sir Robert Hunter, the solicitor to the Post Office, was recalled. He said he had heard the evidence of Sir Courtenay Boyle, and he thought it right to point out to the Committee that there was a great distinction between the cases of electric lighting and of telephonic communication in point of principle. In the case of electric lighting the question was an absolutely open one. Municipalities could supply it and so could private companies—anybody, in fact, could supply electricity to whom Parliament thought it right to give authority. But in the case of telephones, Parliament had said that the Postmaster-General should have the exclusive right of supplying telegraphic communication, and telephones were only one species of telegraphs, and telephonic communication was only another species of telegraphic communication. Therefore, in arranging any system by which they were to give anyone else the power to supply telephonic communication, they would be entrenching upon the field which had been already allocated by Parliament to the State. Of course Parliament could do anything it liked. His contention was that nothing ought to be done to hamper the discretion of the Postmaster-General, and that if there was to be any licensing authority, such as that exercised by the Board of Trade in regard to electric lighting, it ought to be exercised by the Postmaster-General only. The Postmaster-General had already the whole duty of giving telephonic communication. It had been suggested before that Committee that it might be desirable for other authorities to undertake it. If Parliament said that was desirable, and the Postmaster-General had instructions to that effect from the Government, of course he would take steps to administer his jurisdiction fairly, but still regard must be had to the fact that it was his monopoly at present.

Replying to Sir J. Woodhouse, the Witness said he did not think it would meet the difficulty, if a provision were made that the Postmaster-General should give his license before any application could be made to the Board of Trade for an order. That would simply be dividing between two departments the work which ought to be done by one.

Mr. Colville: You don't take the view of Mr. Forbes that the National Telephone Company are partners with the Post Office?—No, I have heard Mr. Forbes say that very often, but that is not the view of the Post Office.

Mr. Boscawen: What do you consider that the National Telephone Company are?—They are the licensees of the Post Office neither more nor less.

Continuing, the Witness said he thought some system analogous to that suggested by Sir Courtenay Boyle might be worked out. Anybody requiring a telephone license might apply to the Postmaster-General specifying the area within which the license was required and the wayleave power required. Then the Postmaster-General might make the same sort of inquiries as the Board of Trade made, and he might invite any objectors, if not a local authority, to state their views, and if necessary he would hold a local inquiry. He wished the Committee to understand that he was not advocating this, he was only suggesting it, if Parliament wished it to be done. If a license were granted with wayleave power, it should be submitted to Parliament, and should not take effect until it had been confirmed by Parliament. There was this further distinction between electric lighting and telephoning. Under the Electric Lighting, Water, Gas, and Tramways Acts, the party empowered by a provisional order had a right to take up the roads on mere notice. The Postmaster-General had no such right. His only power was to apply for the consent of the local authority. The local authority could refuse that consent, whereupon the Postmaster-General had the right of appeal to the county court judge. If a local authority disliked the decision, they could appeal to the Railway Commissioners. This made an enormous difference in practice, and he wanted to submit to the Committee, as one matter, which they might consider when making their report, whether the time had not come when the Postmaster-General and his licensees, under proper restrictions, should not be put in the same position with regard to roads as the undertakers of other great public undertakings were put, and should be at liberty to take up the roads for the necessary purposes of his undertaking on giving suitable notice and subject to supervision, and to the power of the local authority to do the work if it preferred. He thought it was also worth consideration whether if it was desired that telephones should be so largely extended as he had gathered from some of the evidence was the case, the time had not come when the Postmaster-General, and any other persons supplying telephonic communications under proper restrictions, should not have some power of making attachments to private property. At present the Postmaster-General had no power to put wires on or over private property, and they were extremely hampered and delayed both in regard to telegraphic and telephonic communication by this fetter.

Mr. Gaine, general manager of the Telephone Company, was next examined, and in reply to the chairman he pointed out that if the proposals to grant licenses to municipalities were confirmed by Parliament a difficulty would occur in giving trunk line communication to the new exchange areas. The Post Office would probably have to spend £250,000, without a shilling of revenue from it in laying down junction wires between new exchanges and the nearest trunk wire terminal stations. Supposing a corporation was set up as a telephone licensee, it would not be able to meet the needs of the locality. There was no parallel between electric lighting provisional orders and the telephonic business. In a very few districts only, in connection with the electric light, had the local authority jurisdiction beyond its own boundaries.

Sir James Woodhouse: Would not the locality consider what is best for its own interests, and if they saw that by joining surrounding districts they could get a cheaper and more efficient service, their interest would surely induce them to join?—It is possible it would be so.

Replying to Mr. Cawley, the Witness said that the National Telephone Company were anxious to come to an agreement with the Manchester Corporation; but they were bound to do the best they could under the circumstances in which they found themselves. Before they entered into the agreement they knew the Corporation of Manchester was not a possible competitor without the aid of Parliament. He did not object to the Manchester Corporation applying for power to set up competition, but if they were put in that position there should be protection given.

Mr. Stuart: It is perfectly competent for the Manchester Corporation to apply to Parliament for powers, and surely that could not have been absent from the mind of any person who was considering the question of possible competition. Do you mean to say that it was absent from your mind—the possibility of the municipality obtaining Parliamentary powers?—No, I don't want to put it in that way. It was very much present to our mind. We knew that they were not in the position of being competitors, and that they would have to go to Parliament first; and we knew that if we went to Parliament we could rely on the justice of Parliament to get adequate protection.

By Mr. Cawley: If Parliament now said that the Manchester Corporation might go in and compete with the company, then Parliament should say that the Corporation should not withdraw the wayleaves upon which the company had spent about £100,000. The agreement stipulated that it could be terminated on six months' notice being given, but he could assure them that competition by the authority was not contemplated when the agreement was entered into. At the same time, he did not object to the new company which had been formed in Manchester, and he would be prepared to compete with it if it got a license. It was perfectly true that when the negotiations were going on with the Manchester Corporation the Glasgow Corporation had already applied for a license.

Mr. Bartley: Practically, you bought up all the other companies?—There has been very little competition in this country.

But you have bought them up?—There was the Mutual in Manchester. That was the only one of consequence.

And the only difference between a company and a municipality is, that while you can buy up the company you cannot buy up the municipality?—I don't think we could buy up a municipality.

At this point the witness was requested to withdraw from the witness chair in order that Mr. Goschen, First Lord of the Admiralty, might give evidence.

Replying to the Chairman, Mr. Goschen said that he was Chancellor of the Exchequer in 1892, when the Treasury minute was issued, and when the heads of agreement between the Post Office and the National Telephone Company were signed by Sir J. Fergusson.

Do you remember the words of the Treasury minute?—"But it must be distinctly understood, that should such licenses hereafter be granted on other principles no company now or hereafter to be licensed would have any ground of complaint of breach of contract or want of faith on the part of the Postmaster-General?"—Yes.

Was there anything in the heads of agreement which limited the entire discretion of the Post Office in setting up competing licenses. When they were signed, was there any idea of limiting the policy of the Treasury minute?—Not that I can remember, and the policy of the Treasury minute seems to me distinct. I do not think it would have been possible for me to lock up the discretion of the Treasury.

There was nothing said in the interview with Mr. Forbes, which would prevent the Postmaster-General from exercising his discretion to the fullest extent?—Well, that is going rather far. I will read a part of my speech in the House of Commons on March 29th, 1892. It states my policy very clearly:—"Therefore, all the licensees had been warned, and the Government had retained the power in their own hands, and it will not be against either the spirit or the letter of the license if we establish trunk lines. But I do not think it would be against the spirit of the license if we were to take the local arrangements entirely into our hands during the continuance of the license, to the detriment of those who, on the faith of that license, have been extending the system up to the present moment." My recollection and interpretation of that passage would be that, if immediately after the signing of the agreement we had entered into competition with the company, it would have been against the policy we intended, but, on the other hand, our discretion is not hid in any way, though that point should not be pressed too far. The Post Office must retain entire discretion, and I do not think it would be against the agreement to raise such competition as was clearly contemplated, both in the agreement and in the Treasury minute. I think, however, it would have been a surprise to the company, and they would have considered it as hard usage, if the moment after signing the agreement we had established competition against them throughout the country.

But would that have prevented competition in any particular locality?—I should say not.

Then your speech only referred to this, that you considered it would not be fair to extend the principle involved in taking over the trunk wires to the whole of the local exchange?—Yes; we reserved competition in particular areas as a power for ourselves and for succeeding governments, but the idea at the moment was that taking over the trunk lines, was not to establish competition immediately, as we had enough on our hands with the trunk wires.

The Treasury minute was later than your speech, and, therefore, a mere formal embodiment of the Government's policy?—Yes. It seems to me conclusive as to the intentions of the Government.

You gave no assurance to Mr. Forbes that the policy so enunciated would be departed from?—I think it is impossible that I could have done so.

Mr. Cawley: You mean that if competition had been set up immediately it would have been rather "sharp"?—Yes; the company would have been able to complain that they had had no warning.

Sir J. Woodhouse: Would the granting by the Post Office now of a license to a municipality be an evasion of the spirit of the agreement?—I cannot think that it would be.

The Committee adjourned.

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The Committee resumed the hearing of evidence on Friday, Mr. Hanbury in the chair.

Mr. F. Flannery, M.P., gave evidence as to the difficulty he had experienced in getting the National Telephone Company to give him connection. He said that in March, 1893, he entered into an agreement with the company, but it was three years before the connection was made. He brought an action against the company in the public interests for breach of contract, and the jury awarded him £5 damages and costs on the higher scale. The dearness of the subscription, in his opinion, affected the use of the telephone even by important mercantile firms.

Mr. Gaine, the general manager of the National Telephone Company, was recalled to continue his examination, which was temporarily interrupted the previous day, so that Mr. Goschen might give evidence. Mr. Gaine first of all referred to the evidence of Mr. Flannery, and explained that the reason for the delay of which that gentleman had to complain was, that the company could not get the wayleaves to enable them to make the connection to the proper exchange. It all, he said, came back to the old question that they were not given proper facilities for carrying out their business.

Examined in respect to the understandings arrived at between the company and the Post Office, the Witness said he was conversant with and privy to the whole of the negotiations between the company, the Post Office, and the Treasury, which led up to the heads of agreement. He did not think there was any contradiction between the evidence of Mr. Forbes and that of Mr. Goschen and Mr. Arnold Morley. In 1892, when the Government launched their policy and followed it up by the Treasury minute, the company naturally wanted to have a clear explanation of what the policy involved and the Government's intentions. At that time the position of the company was absolutely unassailable by competition, seeing that they had the trunk lines in their hands and the right to open exchanges anywhere. Accordingly they asked the responsible ministers what was intended. There had, he admitted, been a good deal of misunderstanding arising from the use of words, but, while he did not care whether it was called "assurance" or "promise" or "understanding," he asserted that certain explanations were given to them by responsible members of the Government, and on the faith of those explanations they came in, as they were invited to do, and entered into a bargain by which they gave up their position of strength with the view of co-operating with the Government.

The Chairman: Do you deliberately allege, what Mr. Goschen has denied, that, in the face of the clear declaration of the Treasury minute, which was a public document, private assurances were given to you contrary to the tenor of that Treasury minute?—I do not say so. What I do say is, that explanations were given to the company as to what the policy of the Government was intended to be. The Government never hesitated once in saying that they intended absolutely to reserve their discretion. We were told by the Postmaster-General, in my presence, that it was not the policy of the Government to enter into general competition with the company, but to co-operate with the company, and that if a company was not in an area, and would not go in, or if it was in an area and refused to do its duty, then the Post Office, either by itself or through some other licensee, would come in. On the faith of what we were told was the intention of the Government, we surrendered a position which we knew was unassailable.

Continuing, the Witness said there was no record made at the time of these "understandings," but he was perfectly sure that they were given to understand that the policy of the Government was to co-operate with them, and not to work in competition with, or in opposition to the company.

Were you led to understand that in no place where you were working would the Post Office work against you?—Yes, so long as we were doing our duty.

You got that distinct intimation from the Postmaster-General?—Yes; we had a distinct intimation that that was the policy of the Government.

Continuing, the Witness said that, as a matter of abstract right, the company could not claim to have the country parcelled out to them in areas just as they chose, but as a moral right they were entitled to go to the Postmaster-General, and if they could satisfy him that they could do telephone business in a certain area, they were entitled to have that defined as an area. Assuming there was to be municipal competition, he claimed that the company should have some Parliamentary protection in respect of the agreements they had entered into with many of the large corporations at a time when the municipalities were not possible competitors. These agreements had involved an expenditure of £1,000,000 to the company. It was essential, in justice to the company, that Parliament should provide that there should be an appeal against the absolute veto of the local authority. Municipalities would have wayleave powers, and they could deny them to the company. That was not competition. If a municipality exercised their power of veto there should be a right of appeal from the local authority the same as the Post Office had—viz., first of all to the local Court of Summary Jurisdiction, and, secondly, to the Railway Commissioners. In the event of such licenses being granted, he said it would be most unjust if the period during which they should run were extended beyond the period of the company's license—viz., 1911. They asked to be placed on a footing of absolute equality, nothing more.

If we put municipalities upon equal terms as regards competition in other respects with you, will you put yourselves on a level with them as regards preferences and the obligation to serve alike?—I should say certainly.

Let me remind you that I put these very questions to Mr. Forbes, and he refused to do this except at a price?—I think Mr. Forbes was a little more cautious than I am. Mr. Forbes said he was quite willing to consider the matter at a price, and I say the price is equality.

That is to say, supposing licenses to municipalities were to cease in 1911—that is, at the same time as yours—and you had the same wayleave rights underground as the municipalities have, you would surrender the right to give preferences, and you would put yourselves under an obligation to serve everybody?—I should say certainly.

You are authorised to say that on behalf of the National Company?—I have not absolutely consulted my board, but I will take the responsibility of saying it. He calculated that 82 per cent. of the ratepayers of the kingdom would never become subscribers to a telephone service. If municipalities conducted these licenses at a profit, then they made it almost impossible for the State to resume possession of the telephones at any future time.

The Committee adjourned.

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The Select Committee on telephones resumed its sitting on Tuesday, Mr. Hanbury again presiding.

Mr. Robert Gibson, the Lord Mayor of Manchester, was the first witness, and replying to the Chairman, he said that his main object in appearing before the Committee was to be allowed to contradict the statement made by Mr. Gaine, the manager of the National Telephone Company, to the effect that the negotiations between the Manchester Corporation and the neighbouring local authorities as to the working of the electric tramways had completely broken down. That was not correct, and as a matter of fact the arrangements were in a most satisfactory position. The Manchester Corporation had entered into a special agreement with the National Telephone Company as to the granting of underground wayleaves, but there was nothing at all in the agreement which could create a monopoly for the company. Competition was, in fact, specially reserved. The Corporation paid the National Telephone Company about £1,000 a year for their telephone service. It was his opinion that the whole of the telephone service should be in the hands of the Post Office.

Do you think Manchester could manage a telephone service?—No doubt it could, as well as anything else; but, as I have said, I think that the service should be in the hands of the Government.

The Chairman then invited Mr. Gaine to make any statement he wished to respecting the witnesses' contradiction of his previous evidence, and Mr. Gaine said he regretted that he should have said anything that offended the susceptibilities of the Manchester Corporation. The statement which he had made to the Committee as to the negotiations between the Manchester Corporation and the surrounding local authorities was founded on reports in the Manchester press.

Mr. Lamb, the second secretary to the Post Office, was again recalled, and in reply to the Chairman said he wished to say that the opinions he was about to express were his own individual opinions, and not those of the present Postmaster-General. While it was impossible not to sympathise to a certain extent with the Corporation of Glasgow, he could not agree with the remedies proposed by the Corporation. He was sure that the granting of municipal licenses would strengthen the hands of the Telephone Company, because, as a general principle of competition, the municipal system would fail. Both Mr. Goschen and Sir William Harcourt were of opinion that if licenses were given to the corporations, it should be on the condition that the corporations purchased the local systems of the company.

The Chairman (?): That statement is so important that we cannot take it on second-hand evidence. The Committee must consider whether this is to be allowed.

Continuing, the Witness said that in Glasgow, the Chamber of Commerce and the most influential newspapers were not in sympathy with the movement for a municipal service. He was of opinion that the municipal competition with the company must fail, even in the few cases where the corporations desired to have licenses. If the municipal system failed, the company would have a greater claim for goodwill in case of purchase. But supposing that the municipal system did not fail, then, having proved themselves proper authorities for administering the telephone service, the municipalities must retain the administration for all time; and it became at once a question whether Parliament was to rescind its decision placing the telephone service in the hands of the Post Office. The corporations would not be willing to accept licenses terminating in 1911; and in any case their licenses would strike at the root of any development of the telephone system in the rural districts. If the most profitable part of the telephone business were to be handed over to the municipalities, no one would undertake the cost of establishing the telephones in the country areas. Hitherto the municipalities had adopted a very courteous and friendly attitude towards the Post Office in the matter of wayleaves, but the position would be completely changed when the municipalities became the competitors of the Post Office. Then, under any system of municipal licenses, the difficulties of administration at the Post Office must be greatly increased. There would be innumerable managers to settle with, and much more work in auditing the accounts. The municipalities would not give any trunk system such as the Post Office gave. Of course, he was arguing from the point of view that the municipalities' licenses would not be temporary. As to terminals, it would, he contended, be absurd to expect efficient and harmonious working between the different municipal exchanges in the country. The tendency would be to retard the development of the trunk wire system. Under the Post Office the revenue from the trunk wires had

increased from £7,122 in April, 1896, to £13,222 in April, 1898. The want of harmonious working between local exchanges would be the greatest obstacle to a truly national service, and the granting of municipal licenses would encourage further inroads on the monopoly of the Postmaster-General in regard to every new telegraphic invention. As to the question of telephone licenses being granted by the Board of Trade under provisional orders, just as electric lighting orders were granted, he thought there was no analogy between the two cases. Electric lighting was the business of no Government department, while the telephone service was the business of the Post Office. It was not reasonable that the Board of Trade should govern the discretion of the Treasury and the Post Office as to supply and price. Then as to the Post Office itself granting provisional orders, it was erroneous to suppose that the National Telephone Company was the mere licensee of the Postmaster-General. Undoubtedly it was under the original license, but now the Post Office had entered into a working agreement with the company for that co-operation, alliance, and harmonious working which were mentioned by ministers in debate and by the Treasury minute.

You heard Mr. Goschen's views as to what "co-operation" meant?—Yes; but it must be difficult for a minister, who has so many important things to attend to, to remember all that passed. But what I have said is distinctly on record.

I suppose you do not come here to contradict what Mr. Goschen has told us?—Certainly not.

Do you mean to say that this promise of co-operation is an obstacle to competition?—The suggestion was that the Post Office should give provisional orders and hold inquiries as to the desirability of licensing authorities, and his contention was that it was contrary to reason for the Post Office to grant licenses one week and hold inquiries another week that might operate against the licensees. The two ideas were distinctly contradictory. He was not the author of the phrase "partners" in connection with the Post Office and the National Company, but he should describe the latter as people who were under a working agreement with the Post Office, which showed that they were something more than licensees. He considered that the greatest development of the call system might be expected at the hands of the Post Office, though the matter was one which could only be tested by experience. He considered that the telephones should be left in the hands of the National Company until 1911. To allow competition in the meantime would be to bring about confusion, inconvenience, and waste.

Sir Samuel Johnson (Town Clerk of Nottingham) representing the Municipal Association gave evidence, and said that they were almost unanimously in favour of the telephonic service being taken over by the Government, and failing that, by the municipalities themselves. In Nottingham they had an agreement with the National Company, and both inside and outside the city the people were quite satisfied with the service.

Mr. J. Gavey, second assistant engineer-in-chief to the Post Office, was examined concerning the telephone system in Switzerland. He described the process of sending "phonograms" over subscribers' wires. These were received in a central room, where they were written down by clerks and despatched. For this service an initial charge of 2d. was made, and ½d. for every five words, so that a message of 40 words could be sent for 6d. A small charge to subscribers was made for all messages on the telephone over and above a certain number. The effect of that charge had been very curious. The average number of talks per subscriber had dropped from 880 to 546, through fear of exceeding the number allowed—800, and great care was taken not to talk unnecessarily. The total charges, taking tolls and subscriptions together, amounted to £3 16s. per annum for each subscriber. It was clear that the service was worked at a loss, although it was not possible to say how much, as the Government capital charges and accounts generally were so thoroughly mixed up.

Mr. Provand, M.P., submitted reports received from 23 foreign cities bearing on the question of the telephone service.

The Committee then adjourned.

## PARLIAMENTARY.

### Metropolitan Electric Supply Company's Bill.

On Tuesday last, before Mr. Brynmor-Jones, a Select Committee of the House of Commons sat to inquire into the Bill of the Metropolitan Electric Supply Company, by which the company seek powers to enable them to establish a large generating station at Willesden, and to bring the current into the company's area of supply by a conduit laid along the Grand Junction Canal. Mr. Balfour Browne, Q.C., Mr. J. D. Fitzgerald, Q.C., and Mr. Moon, appeared for the promoters. The opponents were the St. Giles's District Board of Works, for whom Mr. Courthope Munroe appeared; and the London County Council, who were represented by Mr. Worsley-Taylor, Q.C., and Mr. Lewis Coward.

Mr. Balfour Browne, in opening the case for the company, said that the Bill really had nothing to do with the districts in which they were authorised to supply, but was simply to enable them to procure a site at Willesden for the purpose of generating electricity. The capital of the company was originally £250,000, but had been increased to £1,000,000. A total of £782,500 had been spent on works, there being five generating stations, one each at Sardinia Street, Rathbone Place, Manchester Square, Amberley Road, and Whitehall. The company commenced supplying in 1891, but the rate of increase had since been so great that they arrived at the end of their tether, and had to buy electricity from other companies to meet their wants. It was found almost impossible to enlarge the present works, and a new site was therefore sought, and a very excellent one had been found at Willesden, which possessed great advantages. It would enable the company to get their mains into their district of supply without breaking up any streets or roads, inasmuch as they were to be laid along the footpath of the Grand Junction Canal. The cost of the site was £12,500, and that of the works upon the site and the mains, &c., £400,000. The works would be such as to give a continuous current by means of rotary transformers. The St. Giles's District Board of Works said they were apprehensive that the new generating station would be substituted for one already existing in their district, and that there would then be no generating station for them to acquire, and consequently, if they wished to purchase, that they would be only able to acquire cables, wires, and mains. They therefore suggested that the company should be placed under obligation to continue the existing generating station. That, however, would be putting upon the company an obligation which they were not now under, because they could abandon that station to-morrow if they liked. Further, they assumed that they would be able to buy that station, but that was not so, because that station supplied two other districts, who had as much right to that station as the petitioners.

Mr. Courthope Munroe said it was quite clear that the St. Giles's District Board of Works had the absolute right of buying the Sardinia Street generating station. There was no doubt it supplied the Strand and Holborn districts as well, but the persons who, under the Act, now had the right of purchasing the station as well as the pipes and mains were the St. Giles's District Board.

Mr. Balfour Browne said he denied that, but even presuming that the Board had the right to purchase, the company beyond doubt could do away with the station altogether if they liked.

Mr. F. Bailey, A.M.I.C.E., engineer and director of the Metropolitan Electric Supply Company, was then examined. He explained that when the company was first established, a high pressure alternating current was adopted on the advice of Lord Kelvin, Dr. Hopkinson, Prof. Geo. Forbes, and Mr. Preece, as being the most suitable at that time. It was now, however, decided to adopt a continuous current to supply electrical energy. He considered that the proposed site at Willesden admirably adapted for the purpose of a generating station, bounded as it was by railways, a canal and a roadway. There was no obligation imposed on the company under any of its provisional orders to lay down and maintain a generating station within any area of supply, except in the case of Paddington. The existing Sardinia Street station supplied the areas of the Holborn District Board of Works, the St. Giles's District Board of Works, the Strand District Board of Works, and part of St. Martin's.

Mr. Worsley-Taylor, on behalf of the London County Council, urged the Committee to insert clauses, which would enable the County Council to purchase the undertaking at the expiration of the statutory period of 42 years. He said that if the Bill was passed in its present form it would render the right of purchase which the local authorities at present had under the existing law absolutely inoperative. Each separate parish had at present the right to purchase so much of the undertaking as was situated within its limits, but distributing mains without a generating station would be useless. The local authorities had recognised the necessity in the changing circumstances of electricity supply of preserving their rights of purchase, and in conference had expressed the opinion that the London County Council should be in a position to undertake the supply of electricity in bulk to local authorities if so requested. The County Council had ample means and the staff necessary for the purchase and carrying on of a large electrical undertaking.

Mr. Courthope Munroe having addressed the Committee, evidence was called on behalf of the St. Giles's District Board of Works.

After a short deliberation in private the Committee announced that they had decided that the preamble of the Bill was proved.

Replying to Mr. Lewis Coward and Mr. Courthope Munroe, the Chairman said the Committee had considered the question of purchase, and had decided not to impose fresh conditions in regard thereto on the promoters.

## LONDON COUNTY COUNCIL.

The final meeting prior to the long vacation took place on Tuesday, when Mr. T. McKinnon Wood, Chairman of the Council, delivered his annual address. In the course of his review of the year's work the Chairman referred to electric traction and cognate subjects as follows:—

### The Chairman and Electrical Matters.

I cannot help thinking that much is to be hoped from the development of the tramway system and the employment of electric traction. Everyone who has studied the question knows that there is room for multiplying the mileage of our tramways; and it was only the other day that a Committee of Parliament expressed the strong opinion that the application of electric traction should not be further delayed. It appears evident that it would be immensely to the advantage of London to complete, accelerate, and cheapen this great means of communication, which is for many reasons one of the most convenient for a working-class population. Two recent events of considerable interest were the conferences held in this chamber on the telephone question and the supply of electrical energy in bulk. The earlier of these, which dealt with the telephone question alone, was the first conference held by the Council with the other great municipalities of the kingdom—a most interesting and valuable precedent. The second was

attended by all the local authorities of London save one, which did not, I believe, intentionally stand aloof. It was the most completely representative conference of the kind in my experience. At the request of these conferences evidence was given by the chairman of the Highways Committee, Mr. Benn, before the Committees of Parliament dealing with the telephone question and the supply of electrical energy in bulk.

The Parliamentary Committee also recently invited the local authorities directly interested to discuss with them the light railway schemes affecting the suburbs of London. The meeting was presided over by the chairman of the Committee, Mr. Cornwall, and it was unanimously resolved that as these schemes were really proposals for the construction of tramways, they should be subject to the provisions for protecting the interests of local authorities which have been inserted in all tramway legislation since 1870. The scheme objected to—the London, Barnet, Edgware and Enfield Light Railway Order, was not entertained by the Light Railway Commissioners, who declined to override the views of the local authorities.

THE TRAMWAYS AND ELECTRIC TRACTION.

The Highways Committee presented a report, which was referred to in our last issue, stating that it was expedient that a tramways department should be established for the purpose of dealing with all matters relative to tramways, acquired, or to be acquired, by the Council. There was no doubt that, in the near future, many important questions would arise as regards the management of the tramways when acquired, the systems of traction to be adopted in preference to the present system of horse traction, and many other matters connected with the working of tramways, and these would have to be dealt with. It was, therefore, desirable in the public interest, that the best advice obtainable should be at command in order to indicate to the Council what would be the most efficacious way of utilising the tramways to the utmost extent. The Committee accordingly recommended that a tramway department should be formed, and that it should be referred to the Highways and General Purposes Committee to confer and report upon the organisation of the department, and to advise the Council upon the question of the salary to be paid to the chief officer of the department.

Mr. J. W. BENN, in moving the adoption of the recommendation, stated that by Christmas the Council would be called upon to administer about 70 miles of tramway, or about double that existing in Glasgow. It would be necessary at an early date to inquire and report upon the question of electric traction. Besides, they could not afford to ignore the strong recommendation from the Joint Committee of the Lords and Commons a few weeks ago. That was a question which could not be put upon the present officials of the London Tramways Company. Then, again, with regard to the lease to the North Metropolitan Tramways Company, the Council had power under the lease to lay down an experimental line of not more than five miles, and up to the present the Committee had not gone beyond the stage of preliminary inquiry. After the recess it was proposed to bring up the question of appointing a responsible officer.

After considerable discussion, in which two amendments were moved and rejected, the original recommendation of the Highways Committee was, on a division, carried by 75 votes in favour to 35 against.

## NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

### NEW PATENTS.—1898.

*Compiled expressly for this journal by* W. P. THOMPSON & Co., *Electrical Patent Agents, 322, High Holborn, London, W.C., to whom all inquiries should be addressed.*

15,208. "Improvements in electric heaters." E. E. GOLD. Dated July 11th.

15,222. "Improvements in electric accumulators." H. H. LAKE. (J. Burns, France.) Dated July 11th. (*Complete.*)

15,235. "Improvements in electrical time switches." A. J. WHEATLEY. Dated July 12th.

15,246. "Improvements in automatic break or interrupter apparatus for electric currents." T. B. KINRAIDE. Dated July 12th. (*Complete.*)

15,285. "An electrical generator." G. E. ADAMS. Dated July 12th.

15,300. "Improvements in electrically heated rolls for drying paper or fabric and for similar purposes." F. P. SNOW. Dated July 12th.

15,303. "An improved method of and apparatus for generating and utilising electricity." H. H. LAKE. (J. J. Feely, United States.) Dated July 12th. (*Complete.*)

15,304. "Improvements in and relating to primary batteries for generating electricity." J. B. LEE. Dated July 12th.

15,346. "Improvements in secondary batteries or electric accumulators." J. I. COURTENAY. (C. A. Faure, France.) Dated July 12th.

15,347. "Improvements in electric switches." J. G. DIXON. Dated July 12th. (*Complete.*)

15,349. "Improvements in and relating to moulds for casting electrodes." E. FRANKE. Dated July 12th.

15,359. "Improvements in electric arc lamps." W. E. BURNAND. Dated July 13th.

15,421. "An improved electric lamp shade and terminal combined." A. M. DAY and H. W. COLE. Dated July 13th.

15,443. "Improvements in electric switches." VERITYS, LIMITED, and L. J. STEELE. Dated July 14th.

15,463. "Improvements in porous cells or porous division plates for primary batteries, electrolytic cells and the like." F. J. GILLIBRAND. Dated July 14th.

15,467. "Improvements in electric time switches." C. O. BASTIAN and A. H. GIBBINGS. Dated July 14th.

15,473. "Improvements in or relating to electrically operated station indicators or the like." J. WYNES, L. W. PERRYMAN, and J. C. LLOYD. Dated July 14th.

15,493. "Improved electric hippodrome and apparatus for use therewith." A. H. R. PULMAN and G. CUDDON. Dated July 14th.

15,496. "Improvements in or relating to electrical time switches." T. B. BROWNE and F. L. MARTINEAU. Dated July 14th.

15,509. "Improvements in electric clocks." H. WHIDBOURNE and A. E. J. BALL. Dated July 15th.

15,548. "Improvements in electrical tumbler switches." R. G. EVERED. Dated July 25th.

15,573. "An improved process for the manufacture of metal paper by electro-metallurgy." I. LANDAUER. Dated July 15th.

15,613. "Improvements in electric and other pressure motors." R. C. SAYER. Dated July 16th. (*Complete.*)

15,646. "Electrically operated cloth cutters." N. GARLAND. Dated July 16th. (*Complete.*)

15,647. "Improvements in electrically ignited fuses for blasting purposes." H. BETTERMANN. Dated July 16th. (*Complete.*)

### ABSTRACTS OF PUBLISHED SPECIFICATIONS.

*Copies of any of these Specifications may be obtained of* Messrs. W. P. THOMPSON & Co., 322, High Holborn, W.C., *price, post free,* 9d. *(in stamps).*

1898.

67. "Improvements in holders for electric glow lamps." THE EDISON & SWAN UNITED ELECTRIC LIGHT COMPANY, LIMITED, H. C. GOVER, C. F. PROCTOR, and W. G. PIPKIN. Dated January 1st, 1898. Relates to a simple construction of the holder for an electric glow lamp. It consists of a non-conducting base, which is divided longitudinally into two parts, one of which has two recesses, in which are placed the spring contact plungers having the conducting wires attached to their base. The two parts are held together by a casing, on which is screwed a cover which may hold a reflector. According to the modification, the two parts of the base are equal and similar, each having one plunger socket embedded in it, the wires being fixed by set screws before inserting the socket. 2 claims.

305. "Device for preventing the displacement of the roller receiving the current from cables of electric railways with overhead conductors." P. MEYERSFELD. Dated January 5th, 1898. Relates to a method of overcoming the difficulty that frequently occurs with electric railways worked on the overhead system, that where there are sharp curves the arm carrying the current receiving roller cannot adjust itself to the new line of direction. It consists in the arrangement of a spiral spring between the roller and the arm which will yield at sharp curves, since it readily gives both axially and tangentially, thus enabling the roller to take the required direction and obviating straining. 1 claim.

817. "Improvements in electric railway conduit systems." R. THOMPSON and E. SULLIVAN. Dated January 11th, 1898. Relates to improvements in electric railway conduit systems, and consists of two chambers of substantially inverted trough shape, one chamber being located on either side of the trolley slot. The side walls and roof of these chambers are air and water-tight. The only manner in which water can enter the chamber is by means of the bottom when the conduits become flooded, and in that event the water cannot rise to a sufficient height to reach the trolley wires which are suspended from the roof of the chambers. The above construction is only effective when the tracks are perfectly level their entire distance. When the grades change the air and water-tight partitions or diaphragms are provided, one in each chamber. 3 claims.

1,379. "Improvements in electrical conduits, and in the method of and apparatus for making same." P. M. JUSTICE. (Lithosite Manufacturing Company.) Dated January 18th, 1898. Relates to an improved method of making electrical conduits, which consists in winding a fibrous material, preferably treated with a cementitious substance on a suitable mandrel by which said conduit is given its shape. Then hang the mandrel by one end so that the conduit will slip off by its own gravity, which polishes the interior thereof, giving the said interior a certain grain, or fibre, and preserving its shape so that when said conduit has passed from its mandrel it will harden in the shape desired. 10 claims.

1,416. "Improvements in telegraphic transmitters." S. PRICE, W. PHILLIPS, and R. WEINY. Dated January 18th, 1898. Relates to a keyboard transmitter provided with means for transmitting electrical impulses in the nature of a Morse code over a telegraphic line in combination with a propelling mechanism, therefore adapted to enable the operator to store up the prepared record in advance of its transmission and at any speed desired, together with the additional propelling mechanism for causing the transmitted impulses to be sent at a substantially constant speed. 14 claims.